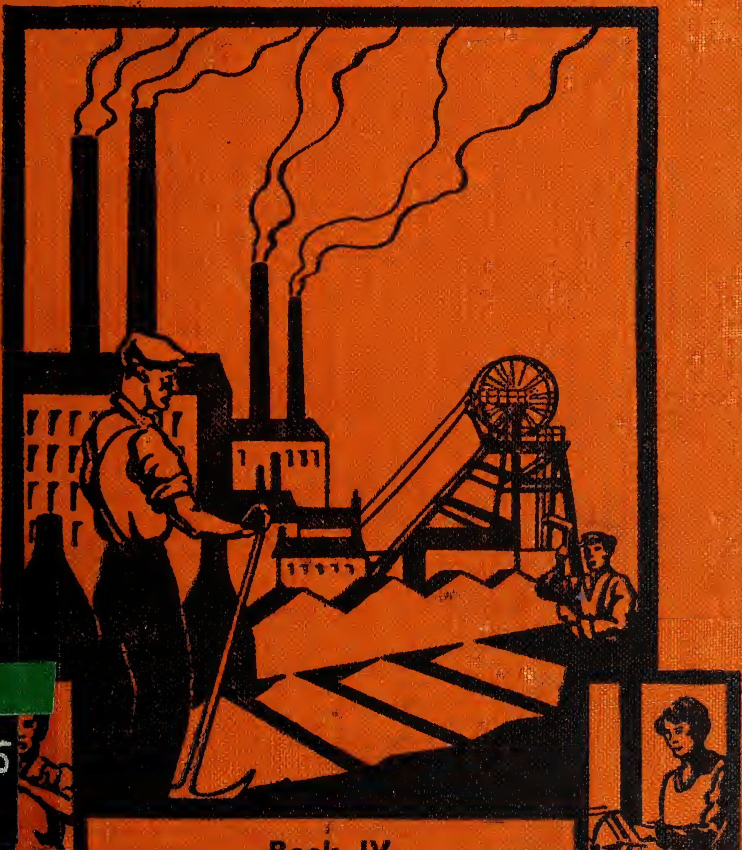
THE KINGSWAY

SOCIAL GEOGRAPHIES

edited by ERNEST YOUNG



Book IV

MINERS AND MANUFACTURERS

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THE KINGSWAY SOCIAL GEOGRAPHIES

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MINERS AND MANUFACTURERS

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PREFACE

THIS series of five books, of which this is Book IV, is intended for use by pupils from the age of about elevenwards, and each book provides a course of work that should take about half the school year. The language throughout the five books has been kept as simple as possible.

The complete series covers the geography of the whole world, but it is not concerned with an excessive number of unrelated facts. By means of living races and present conditions, it seeks to tell a continuous story of the evolution of culture. The material is, when suitable and available, taken mainly from different parts of the British Empire, but all the more important parts of the world as well as of the Empire are dealt with somewhere in the series.

The exercises are varied in difficulty in order that they may meet the needs of those different grades of ability that are usually to be found in one and the same class.

If geography is worth studying at all, it is not for the accumulation of a mass of information, most of which will certainly be forgotten, and much of which may soon be out of date, but for the acquisition of a body of ideas that may leave some kind of permanent outlook upon life and its problems.

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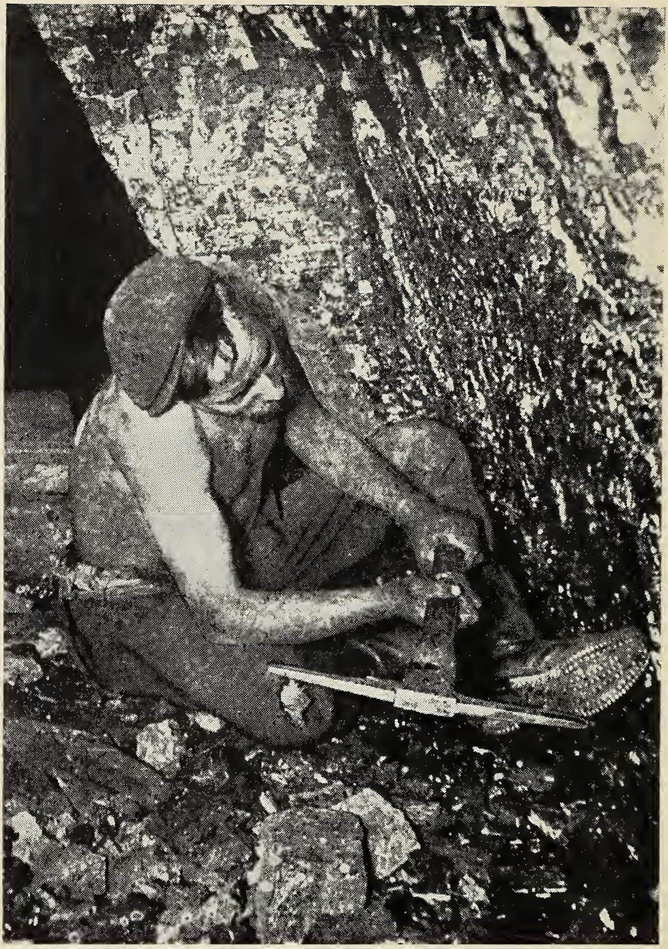


[Topical.

A miner hewing coal with a pick.

PART ONE: THE MINERS

CHAPTER I

THE POTTERS

IN the first three books of this series we have seen how the large-scale farming of our own time—for meat, dairy produce, and all kinds of cultivated grain, fruit, fibre—grew from the early efforts of man to obtain a regular supply of food.

In this book we shall look at the great modern industries of mining and manufacturing, and we shall find that they, too, began in a very humble way a long while ago.

One of the oldest arts of man is that of making pottery. It seems likely that he learned to make pottery almost as soon as he learned to cultivate grain, and it is certain that earthenware vessels were being made in Egypt at least seven thousand years ago. We do not know exactly how man found out that by baking clay he could make a pot that would hold water, but if we go to Guiana or Northern Nigeria, and watch the people of these lands making pots at the present time, we may obtain some idea of how the early potters went to work.

In Guiana the potters make a round flat cake of clay and also a number of thin clay rolls, each about a foot long. They place one of the clay rolls round the edge of the flat cake and press it down tightly. The other rolls are built up on the top of the first, one after the other, until the vessel is finished. The vessel is then placed at the bottom of a hole in the ground, covered with a fire of wood, and baked.

The people of Northern Nigeria use another method. They

An Indian potter making a jar on a potter's wheel. [E.N.A.

make a basket of wickerwork, smear it all over with clay, and put it in a fire. The wickerwork burns away, but the clay is baked into a vessel of the same shape as the basket.

In some such simple ways did the making of pottery begin. Then someone made the great discovery of the potter's wheel. He found out that if he put some clay on a stone and turned the stone quickly round and round, every bit of the clay passed under his hand in turn, and he could shape a pot more easily. At an early date he also discovered how to glaze pottery, that is, how to cover the outside with something that would prevent water from soaking through it.

To-day most of the pottery we use is made in factories, but though much of it is squeezed into shape under a press, the

very best kind is still made on a potter's wheel. The wheel, however, is now a round flat plate, and it is turned either by the foot or by a machine.

A man, called a " thrower," stands or sits by a table above which the wheel turns round and round. He puts the proper weight of clay on the wheel, and as it spins he shapes the clay, partly with his hands and partly with the help of a few simple tools. By his side, on the table, is a bowl of very watery clay. Into this he dips his fingers and wets them, so that they will not stick to the vessel he is shaping. By doing this he also gives the vessel a smooth appearance.

When the article is finished, it must be baked to make it hard. The oven, or *kiln*, in which the baking takes place, looks something like a huge beehive about twenty feet in

[Fox Photos.

A modern craftsman at work at a potter's wheel.

height. The pieces of pottery are placed in boxes made of fire-clay. These are stacked in piles, and there may be forty or fifty of these piles with about fifteen boxes in each.

When the kiln is full, the doorway is closed with bricks and mortar and the fires are made up. Hot air from the fires passes up from the bottom to the top and then escapes. After two days the fires are allowed to die down, but the pottery is left in the hot kiln for several more days.

At this time the pottery is porous, that is, it will soak up water. To make it water-tight it has to be glazed. It is dipped into a liquid which usually contains a certain amount of white lead. The pottery soaks up the water and leaves the glaze on the outside. It is now packed once more into the boxes and baked a second time. This melts the glaze and gives the china its glossy appearance.

In the British Isles the chief place for making pottery is in North Staffordshire; it is called the " Potteries." At one time the potters carried on their work at the backs of their houses amongst the pigs and fowls. They dug their own clay and baked the things they made with coal which was found in the neighbourhood.

The clays of North Staffordshire were very coarse, and were suitable only for such rough articles as stone jars and chimney-pots. Good clay for a better quality of work had to be brought to the district, first from China, and then from Cornwall, Devonshire, and Dorset. The fine china-clay from south-western England is brought by sea to Liverpool, and thence, by the Trent-Mersey Canal, to the Potteries.

The chief towns of the Potteries are Stoke, Burslem, Hanley, Longton, and Fenton. They are so close together that they have been united under the name of Stoke-on-Trent. The Potteries is not a very pleasant district in which to live. There are ugly kilns, coal-mines, and iron-works, and the air is dirty

[Fox Photos.

The kilns in which the pottery is baked.

[Fox Photos.

Girl artists painting patterns on china.

with smoke thrown out from chimneys and pottery ovens. Yet, inside the grimy walls of the factories, artists are at work painting beautiful patterns upon china that may be as thin as egg-shell.

It seems strange that this industry should have grown to be

so important in North Staffordshire. All the clay for the finer work, the material out of which the glaze is made, and some other things that are needed have to be brought from other parts of England. In making pottery, however, the potters use much more coal than clay, and as the Potteries are on the North Staffordshire coalfield, coal is easily and cheaply obtained. It costs less to carry the clay to the coal than it would to carry the coal to the clay.

EXERCISES

1. On a map of England mark the Potteries.
2. On a map of North Staffordshire shade and name the uplands, insert and name the chief rivers and towns. What railway serves this region ?
3. Find out[1] what are—Crown Derby, Dresden China, Deep Royal Worcester. Where is each made ?

[1] This type of question can be answered only by seeking for information elsewhere. It is intended to encourage the use of reference books.

CHAPTER 2

MAN FINDS GOLD

IT is difficult for us to imagine what life was like in a world where metals were not used, yet they have been in use for not more than about five thousand years. This is not very surprising, for few metals are found in the ground in a pure state.

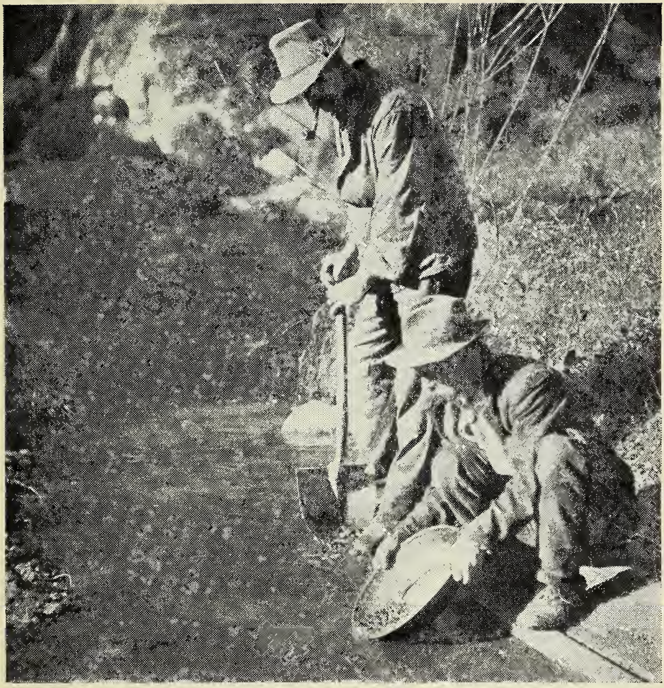
Perhaps the first metal that man discovered was gold. It was mined in ancient Egypt, and there are pictures, painted in Egypt, three thousand years before the birth of Christ, that show men "washing for gold" in ways that we shall presently describe.

Gold is found, ready for use, in veins that run through masses of rock or in the sands of rivers which have washed it out from the rock. It is also found, but not ready for use, mixed with ores, or even, in small quantities, in sea water.

Now we can easily picture to ourselves some early wanderer finding a small nugget of gold in the gravel of a river. Its shining surface would catch his eye, and he would pick it up to see what it was. Perhaps he would try to string it on a necklace with other things that he carried about in this way. He would soon learn that it kept its bright colour and did not go dull and, in boring a hole through it, he would learn that it was soft and could easily be beaten into many different shapes.

We have seen, many times, in the first three books of this series, that all people, everywhere, are fond of ornaments. A nugget of gold that did not go dull made a splendid ornament, but it was not of much use otherwise to early man. It was not found in large enough amounts to be used for spear- and arrowheads, and even if it had been, it would have been too soft.

Strange as it may sound, gold is not of much real use to us either, except for ornaments, for filling teeth, or for spectacle



[Courtesy, Australian Government.

Prospectors panning for gold in a stream.

frames. We do not, in these days, often see it in any other form. Moreover, it is not worth so much as many people think. The value of all the gold mined in the whole world in one year is less than half the value of a single crop of wheat in the one country of the United States of America.

When early man picked up a bit of shining gold he was not

likely to ask himself how it arrived where he found it. He never thought that it had been washed down from higher ground, and that there was, probably, much more of it still left in the mountains. His findings were just luck.

Many important mining areas, in our times, have also been discovered by accident. For instance, one of the Australian gold-fields was brought to light by a dog. The dog was trying to catch a rabbit that had gone down a hole, and as it scratched out the earth it brought up a nugget. Another rich field was discovered by an Australian farmer when he was hoeing the ground round the bottom of a tree. His hoe turned up a nugget of gold worth £8,000.

Nowadays men do not trust to accidents of this kind when they wish to dig for gold or for any other minerals that lie below the surface of the earth. They go to seek for them. They know in what kind of country it is worth while to look and what rocks or soils are likely to contain that for which they are looking. Such men are called *prospectors*.

The life of a prospector is a very lonely one. He generally works alone or, at most, with one other man, and spends his time in wild parts of the earth where no one lives.

The life of a prospector is also hard and rough. He may, sometimes, ride on horseback, and in North-west Canada he may travel by canoe, but usually he just trudges on, on foot, with a pack-horse to carry his belongings.

In rather dry regions the lack of water may cause him a great deal of trouble. He camps at night by the side of a mountain stream or spring. In the morning he fills his water vessels, loads them and all the rest of his gear on the pack-horse, and sets off into the unknown. If no fresh supply of water is met with he has to turn back to the old ground and try in another direction.

The prospector carries nothing that he does not need. He

[Fox Photos.

A prospector sitting outside his log hut.

has a rifle, a blanket, a few cooking utensils, a little spare clothing, a small tent, and his tools—a pick, shovel, hammer, and pan. For part of his food he takes smoked bacon, flour, sugar, dried beans, and coffee; for the rest he depends on his rifle. Hunting for gold, hunting for animals, and hunting for water are his chief tasks day by day.

He looks for signs of gold in river gravels and in rocks. When he comes to a likely stream-bed he tries his luck. If there is gold in the mountains through which the river flows, some of it will be carried down by the water in fine grains, but because gold is very heavy these grains will sink below the gravel in the bed of the river.

The prospector shovels out some of the gravel and places it

[Sport and General.

At work in a South African gold mine.

in his pan. He fills the pan with water and swills it round and round. The gravel is washed over the side of the pan, but the gold, if there is any, remains at the bottom. Time after time he tries, first in one spot and then in another. If he finds no gold he just packs up and plods off to another creek.

The prospector knows that gold also occurs in a rock called quartz, so he keeps a sharp look-out for any likely blocks of stone that have fallen down the mountain-side. If he thinks one of these fallen rocks contains gold, he smashes off pieces with his hammer. He looks at the chips very carefully. If he sees any glittering specks he searches for that part of the steep mountain-side from which the block once fell. If he is not quite sure whether the rock contains gold or not, he takes a few pieces to his camp and there examines them more closely.

He pounds the bits into a powder and washes the powder in the same way as he washes river gravel, but he uses a spoon instead of a pan. A few grains of gold may be left at the

bottom of the spoon. If so, he can tell, from this small sample, whether his find is worth working. If he thinks it is, he sticks up posts to mark the ground as his, and hurries off to the nearest offices where his claim can be recorded.

If he wishes to mine the claim himself he goes back to it, cuts down a few trees, and builds a log hut. He makes tables and chairs out of split timber, sets up a bunk at one end for his bed, and builds a big fireplace at the other to cheer his spirits and cook his food. Over the fireplace he hangs his coffee-pot, the saucepan in which he cooks his beans, and the Dutch oven in which he bakes his meat and his bread.

Sometimes a prospector does not wish to do the mining himself. In that case he goes to the nearest place where people are living, takes his samples with him, and sells his claim.

If the find is a rich one, the news quickly spreads, and there

[Keystone.

A scene during a gold rush in Alaska.

is a " gold rush." Hundreds of people arrive. Some of these are regular miners; others are people who have given up their ordinary work to try their luck.

After a time, on any gold-field, the gold that is easily obtained is soon worked out. It is then necessary to sink mines into the solid ground. This costs a great deal of money. To meet the expense a number of people put their money together to form a company. They are called the shareholders. If the mines make any profits, these go to the shareholders. Then the ordinary gold digger leaves the district or takes up some other kind of work.

Amongst these diggers there are always hundreds of fine, strong men. Very often, when they leave the diggings, they settle down to earn their living in some other way, and are worth more to the country than the gold is. Australia owes a great deal to gold rushes in the early days of her history. People flocked into the country to obtain gold from the river gravels, and when the gold was gone many of them remained in the land and became sheep rearers and farmers.

EXERCISES

1. The following towns are connected with gold or gold rushes. Find them on a map and describe their positions:
Johannesburg, Coolgardie, San Francisco, Klondyke.
2. If all the gold in the world were made into blocks, these could all be packed into two or three school classrooms. What would happen to the price of gold if someone found a mine containing a few more dozen cubic yards of it? Why is gold so expensive? Do you know of any substances more expensive than gold?
3. The following are the chief gold-mining countries of the world, with the number of thousands of ounces that they produced in 1934:

S. Africa	10,480	Russia	4,000
Canada	2,972	U.S.A.	2,775
Australia	887	Japan and Korea	891
S. Rhodesia	691	Mexico	661
Gold Coast	326	Colombia	344

Mark all these countries on a map of the world. Call it " Where we find gold." What percentage of this gold came from the British Empire? [1]
4. Find out where gold is now being mined in the British Isles.

[1] Mathematical and statistical questions are intended only for advanced pupils.

CHAPTER 3

MAN LEARNS TO MOULD METALS

Copper

ANOTHER metal that was sometimes found in a pure state was copper. Copper was much more useful than gold. It was much harder, but not too hard to be hammered. Knives and spear-heads could be made with it, so that those who found copper were able to have better tools.

For a long time men simply used gold and copper to make beads or to hammer into shapes for ornaments and tools. The men who did this were not true metal-workers, just as those who gathered seeds were not true cultivators. It was only when men found out that by sowing seeds they could grow grain that they became cultivators. It was only when men found out that by heating copper they could mould it into the shapes they wanted that they became true metal-workers. This discovery was, in some ways, as important as the discovery of the cultivation of grain.

No one knows how the discovery was made. Most probably a tool of beaten copper fell into the fire. Someone would notice that, while the copper was hot, it took the shape of the small channels in the ashes through which it ran and kept this shape when it cooled. It would not then be long before someone thought of melting copper and shaping it by pouring it into a mould.

We have supposed that the idea of melting a metal came from seeing a tool of pure copper melted in a fire. But copper is not found in a pure state in a large number of places. It is found, like the other metals, in mixtures of metal and rock called *ores*. Before a metal can be obtained from an

ore, the ore has to be heated. It has to be *smelted*, as we say.

We can only guess how smelting was discovered. A man may have placed some rock containing copper round his camp fire to keep it together. This rock would become hot. The copper in it would melt, and then small beads of copper would run to the bottom of the fire. The man would then see that these reddish-yellow beads were of the same stuff as that of which he had made spear-heads.

The fact that we know for certain is that five thousand years ago men had found out how to shape copper by melting it and pouring it into moulds. Those who knew how to do this began to prospect for copper as men prospect for gold and other metals to-day. They thus came to learn of other countries, and to see new ways of living. This was the beginning of those great trade journeys, to countries in which metals were found, which are still going on in our times.

We know that grain growing and cattle herding did not spread all over the world as soon as they were discovered, and that even to-day there are a few tribes who know nothing of either. Similarly metal-working, first practised in the south-west of Asia and in Egypt, did not spread all over the world, and there are still tribes to whom it is unknown.

For many years copper was a very important metal. It lost much of that importance after the use of iron became known, but, to-day, copper is once more of great value, not for making tools and weapons, but for coins, electric cables, telephone wires, and electrical apparatus.

Let us look at two places where it is obtained. In one of them we shall see the work being done mainly by hand, in the other mainly by machinery.

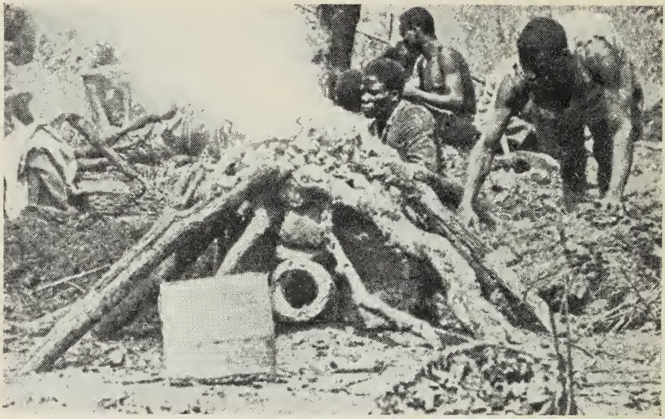
We begin with copper mining and smelting by an African tribe in the very south of the Belgian Congo in Africa. For

[London Museum.

Men grinding, smelting, and casting copper, about 1700 B.C.

hundreds of years the natives of the Katanga region have produced copper from the ores that are found there. At the present time most of the copper is mined on a big scale under the direction of Europeans, but, here and there, the natives mine and smelt in the same way as their forefathers. From their simple methods we can learn much about the handling of ores even in the most up-to-date works.

1. *The first thing is to dig out the ore.* In the Katanga region this is done by the women. Their mining tool is a pick made by wedging an iron spike into a hole at the end of a wooden stick. With the pick they dig big hollows, thirty to forty feet deep. When they reach layers of hard rock that they cannot break with the pick they light fires on them. This makes the ground hot. They then pour water on the fire: this makes the



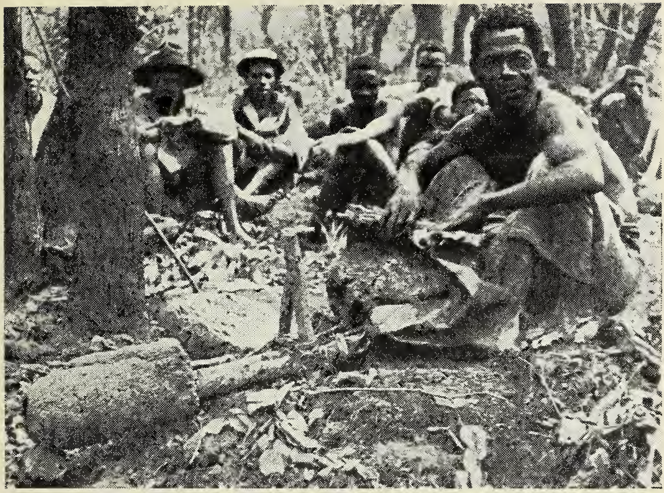
[Courtesy, Union Minière du Haut Katanga.

The furnace used by the natives for smelting.

ground cool. The rapid heating and cooling cracks the hard rock, which can then be broken into lumps.

The women place the lumps of ore in baskets. Up the side of the hollow, on a number of steps, other women sit and pass the baskets from hand to hand till the top is reached. Here the baskets are emptied and thrown back to the miners below.

2. *To smelt the ore a furnace is needed.* The furnaces are small, and several of them have to be made to deal with the many baskets of ore that are sent up from the mine. The builder of the furnace scoops out a shallow hole in the ground and lines this with clay. He next takes four clay cones, bores a hole through them, and lays the pipes down so that they point to the centre of the hollow. We shall see, presently, what is the use of these pipes. Above them and round the hole he builds a clay wall about thirty inches high, and supports it with forked sticks.



[Courtesy, Union Minière du Haut Katanga.

The bellows used to keep the fire alight.

3. *To smelt the ore fuel is needed.* While the fireplace is being prepared another set of people are making charcoal, which is better fuel than wood for smelting ores. The charcoal makers cut up pieces of wood, put them in a hole, and set them on fire. When the wood is well alight the pile is covered with earth. The wood cannot now burn to ashes because there is not enough air. It is charred and turned into charcoal.

4. *To keep the smelting fire alight air is needed.* The air is blown into the furnace through the clay pipes by means of bellows. These bellows are like bags, and are made from the skins of the antelope. Into one end of the bag is fixed a tube made from wet, green bark; in the other end a hole is left.

The blower opens the hole, raises the skin bag till it is full of

air, then grips the sides of the hole to close it and presses the skin against the ground. This forces air through the pipe and sends a strong blast through the furnace. While one skin is being squeezed another is being raised, so that the stream of air into the fire is never stopped so long as it is needed.

For the smelting of all metals these four things are required—ore, furnace, fuel, blast of air.

Amongst the natives of the Katanga region the smelting is a man's work, and the chief smelter is looked upon as a wizard. He is a very wonderful person, for he gets useful metal out of useless stones. Before work begins prayers are said and chants are sung to the spirits in order that the wizard may be successful.

Smelting takes place in the early evening, when the light is fading: the wizard smelter knows that darkness makes him and his work seem more strange and wonderful. A wood fire is lighted in the furnace, and on it lumps of charcoal are placed. When the fire is glowing brightly copper ore and more charcoal are added till the furnace is full. The smelters squat round and chant while the furnace gives off greenish flames.

After about half an hour, when the flames begin to die down, the blowers set to work with the bellows. All night long they blow and sweat while the lookers-on continue to chant and clap their hands in time and the wizard mutters to the spirits. While all this is going on the metal is set free from the ore, runs down over the burning charcoal, and collects in a hollow at the bottom of the fire.

From time to time the chief smelter peeps through the air holes. When he sees that a fair amount of copper has collected he tells the blowers to leave off blowing. The fires die down, the walls of the furnace are broken away, and the embers are scattered over the ground. There, at the bottom of the hearth, is the glowing metal. The wizard always succeeds!

[Courtesy, Union Minière du Haut Katanga.

Natives gathered round the furnace, watching the smelting.

Now let us look at some white men mining copper ore in the United States of America, which is one of the most important copper-producing countries. The present important copper regions are in the Western United States: Arizona, New Mexico, Nevada, Utah, and Montana. (The Lake Superior region is now largely worked out.) The largest single mine is located near the Great Salt Lake at Bingham Canyon, Utah, about 30 miles south-west of Salt Lake City.

At Bingham there is a *mountain* of copper ore. In its side a number of huge steps have been cut. On each step are to be seen many workmen, steam shovels, a perfect network of pipes that supply air to work drills, such as those with which workmen break up roads, but much bigger, and a railway line that

[Courtesy, Utah Copper Co.

The mountain of copper ore at Bingham.

carries huge steel trucks. Each of these trucks will hold eighty tons of rock.

The drill is placed against the foot of the cliff, the air is turned on, and with a deafening noise the bit slowly cuts its way into the ore. When the hole is deep enough the drill is removed and a stick of dynamite, fastened to an electric wire, is pushed into the hole. The men take cover in a hut made of railway sleepers; the engineer in the nearest steam-shovel gives a number of short sharp blasts as a warning signal with his whistle; a loud explosion is heard, and, amid clouds of smoke and dust, tons of rock come tumbling down the face of the cliff.

When all is safe a steam-shovel is brought along to load the

trucks. The steam-shovel is an engine that moves a long arm with a scoop at the end of it. The scoop is pushed into the mass of fallen rock. When it is raised it lifts as much as seven tons of ore at a time. The arm is then swung round and the load is dumped into one of the trucks.

When a number of trucks have been filled, they are made into a train and hauled to a nearby town, where the ore is smelted and the copper obtained.

All copper is not shovelled out of the side of a mountain in this way. Some of it comes from rocks that lie deep in the earth. But in Northern Chile and in the Belgian Congo steam-shovels scoop up copper ore much as they do at Bingham in the United States.

EXERCISES

1. Find out the meaning of—mineral, rock, ore, metal, smelting.
2. For the following things we use metals. Write them down in a list and opposite each say what any primitive people, of whom you have learned, would use in their place: nails, hammer-heads, rifles, ships, buckets, knives.
3. Make a list of ten things in the manufacture of which copper is used.
4. The following are the chief copper-mining countries of the world. The figures give the weight, in thousand tons, of copper produced in 1934:

Chile . . .	260	Belgian Congo .	108
United States .	214	Japan . . .	67
Canada . .	163	Mexico . .	44
Northern Rhodesia	158	Russia . . .	43

World total, 1,280 [1]

Mark these places on a map of the world. Call it "Where we obtain copper." What percentage of the total comes from the continent of North America?

[1] The "world total" here, as in other exercises, includes copper from other countries not mentioned in the table.

CHAPTER 4

MAN LEARNS TO MIX METALS

Tin and Bronze

MAN had now learned how to smelt copper ore. But copper was not a very good material for tools and weapons: it bent too easily and was not really hard.

The next great discovery in metal-working was that by mixing two metals together a new and better material could be obtained. The first of these mixtures, or *alloys*, as we call them, was of copper and tin, and is known as *bronze*. It contained about one part of copper to nine parts of tin.

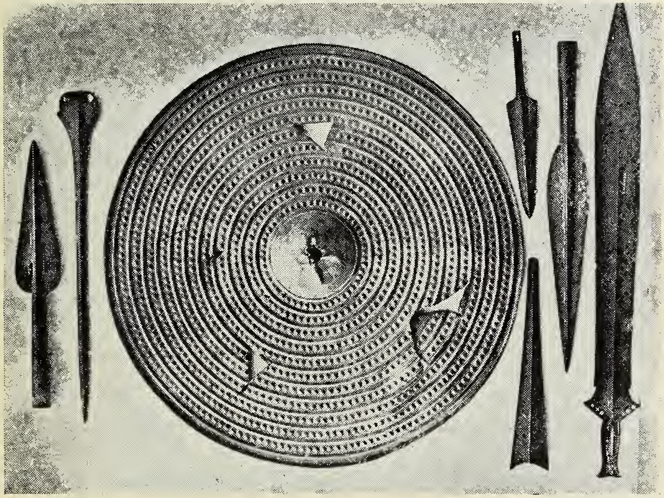
Once more we have to confess that we do not know just where or how the discovery was made, but it was a discovery that led men to try other mixtures, and they have gone on mixing metals to this day. The age in which tools and weapons were made of bronze has been called the Bronze Age. The peoples of Europe and the parts of Asia and Africa near to Europe, as well as those of Central America, all had a Bronze Age, but not all at the same time. Some learned earlier than others how to make alloys.

There was a Bronze Age in the lands round the Ægean Sea at least four thousand years ago, and not long after this the working of metals was growing rapidly in the countries we now call Bohemia and Saxony. From these countries the knowledge spread over most of Europe and over the nearer parts of Asia and North Africa. Beautiful bronze axes, spear-heads, and ornaments are found along all the routes which were followed by the old prospectors for tin and copper.

The people who lived in Europe during the Bronze Age understood how to cultivate grain, rear cattle, and work in

metals. They also made materials for clothing, and used very beautiful bronze pins with which to fasten their clothes. Some of them lived in villages protected by banks and ditches. Others settled near rivers and lakes.

The great thing, however, for us to remember about the



[W. F. Mansell.

A bronze shield and weapons found in the Thames.

Bronze Age is that it set people wandering more than they had ever done before. Because they needed copper, tin, and gold, they went in many directions to look for them. They sailed along the western coasts of Europe and the British Isles, and found the tin of Cornwall and the gold of Ireland. They paid for the ores with pottery, cloth, and trinkets; trade was by barter.

Tin is still a very useful metal, but not much is now needed for the manufacture of bronze. It is now largely used to coat

the thin sheets of iron of which " tin " cans are made. The tin prevents the iron from rusting. Tin is also mixed with other metals to make silver paper, tubes for holding such things as tooth-paste, pewter, solder, and the type that is used in printing.

Then, too, tin is no longer obtained in large quantities in Cornwall. In the days of the Phœnicians, and for hundreds of years afterwards, Cornwall was the most important tin region in the world. Small amounts of tin are still mined in Cornwall, but the ore near the surface has all been used and the mines have now to be dug deep down in the earth through very hard rock. One mine is nearly three-quarters of a mile deep. This deep mining makes Cornish tin very dear.

To-day the world's supplies of tin come from other lands, where the cost of mining the ore is much lower. Amongst these countries are Malaya, China, and the East Indies in Asia, Bolivia in South America, and Nigeria in Africa. The most important country is Malaya, which produces about one-third of the world's supplies.

Very few of the mines in Malaya are really mines. They are more like quarries, and the miners do not often have to work underground. The tin ore is in soft rock near the surface, and can be obtained by digging out huge hollows. This is much less costly than digging deep mines as in Cornwall.

Tin-mining in Malaya is also cheaper than in Cornwall, because labour is cheaper. Most of the miners are Chinese, and think they are earning good wages if they are paid one shilling and threepence a day. It was the Chinese who, hundreds of years ago, first mined tin in Malaya, and many of the smaller mines of to-day have Chinese owners as well as Chinese workers. A few Malays work in the bigger tin mines that belong to the Europeans, but they usually look after the machinery and the water supply, and do not do any actual mining.

[Courtesy, Malay Information Agency.

Coolies at work in a tin mine in Malaya.

When the mine is a small one, the ore is sometimes hacked out of the side of a hole with a hoe. It is then put into wicker baskets, one of which hangs at each end of a bamboo pole. A coolie, that is, a labourer, places the pole across his shoulders and trots up to the surface by means of notches cut in a tree trunk.

If the bottom of the hollow is very wet, the earth is churned up into a thick sludge. In the sides of the hollow a number of ledges have been cut and a coolie sits on each ledge. The Chinaman at the bottom has a bucket at the end of a pole. He spoons up a bucketful of mud and swings it on to the ledge above him. Here another coolie scoops it up and passes it on. In this tiring way it reaches the surface.

Sometimes a number of buckets are fastened to an endless

chain. The chain passes over a cogged wheel at the top while the lower buckets dip into the mud below. A man on a tread-mill causes the cogged wheel to turn round, and so slowly brings up the buckets full of mud and tinstone.

The bigger mines belong to British companies, but Chinese coolies do most of the work. They live, at the mine, in one large building made of bamboo poles with roof and walls of palm leaves. They rise before the sun, eat a breakfast of boiled rice, and are at work before it is light. They stop, at half-past ten, for a dinner of rice, with perhaps a little fish or vegetables, and take their last meal at five in the evening. Their work under the white man is, perhaps, less hard than that of the coolies in the smaller mines, because they are helped by machinery.

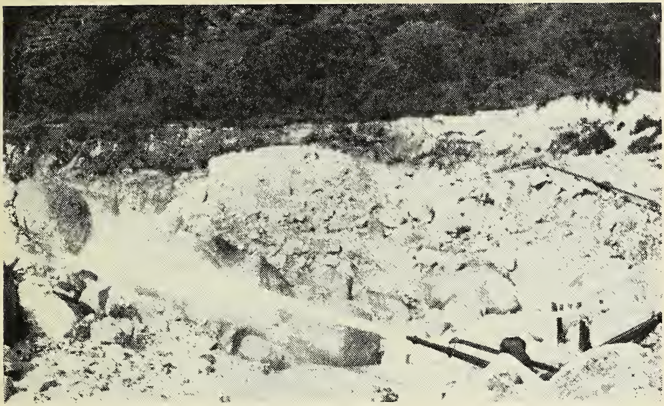
The ore is brought to the surface in several different ways.

In some of the hollows the digging is done by a steam-shovel that lifts several tons a minute and dumps them into a truck on a railway line. Every day the hollow grows bigger and bigger. Some of them are so large that twenty games of football could be played on the floor at the same time.

Where the bottom of the mine is under water the tin-bearing earth is often brought up by a dredger, such as is sometimes seen in a harbour. A chain of buckets keeps going round and round, each one scooping up a mass of sludge and tipping it into a chute at the top.

Another method of mining uses the force of water. Across the base of the hollow are laid down dozens of iron pipes, in which there is water at a very high pressure. Hose pipes are attached to these, and the Chinese coolies squirt jets of water, like firemen, at the wall of the mine. The force of the water is so great that it breaks down the crumbly rock and sends it flowing along a wooden trough.

Before the grains of ore can be smelted they have to be



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Mining tin by forcing water at high pressure against the rock containing tin.

separated from the useless earth. At the smaller mines owned by the Chinese, this work is generally done by Chinese women. Each woman has a shallow wooden dish, or pan, about two and a half feet across. She scoops up some of the mud and water and swirls the contents round and round in the pan. The mud, being the lighter, is washed over the sides while the heavier tinstone remains at the bottom. After several washings with fresh supplies of water the tin ore is turned out on to a heap and another pan full of mud is dealt with.

At the large mines the sludge is sometimes washed by women using a pan, but in other cases the tinstone is separated by the flowing water in the chutes or troughs mentioned above. In the trough stands a Chinaman raking the mud backwards and forwards. The earthy matter is washed away; the heavier tinstone remains, is scooped out, and placed in a heap.

The chief places where the ores are smelted are Singapore

and Penang. Here are the two largest tin-smelting works in the world. The ore may be sent direct by rail from the mine to Singapore, but if the mine is far from a railway, the ore may be carried by lorry or bullock wagon or even by elephants to the nearest railway siding.

From the smelting works most of the tin is shipped to London. Much of it is then sent to South Wales for the manufacture of tin plate.

EXERCISES

1. What importance had the discovery of tin for early man?
2. Name five things in the making of which tin is used.
3. Fill up the following table to show differences in tin mining.

TIN MINING

	Cornwall	Malaya
Getting the ore		
Bringing the ore to the surface .		
Labour		

Show why, in each section, tin from Malaya is cheaper than tin from Cornwall.

4. Draw a map of the Malay Peninsula and the East Indies. Shade the high ground. Name the seas, principal islands and straits, and the chief towns.
5. The following are the chief tin-producing countries of the world. The figures give the weight of tin, in thousand tons, mined in 1934:

Malaya . . .	38	China . . .	8
Bolivia . . .	23	Nigeria . . .	5
Dutch East Indies .	19	Belgian Congo .	4
Siam . . .	10	All other countries .	14

Mark these places on a map of the world. Draw a circle with its centre at Bangkok, in Siam, so as to include China. What percentage of the world's tin lies in this circle?

CHAPTER 5

THE LAST GREAT STEP

The Working of Iron

THE very last of the great discoveries of ancient man was a knowledge of iron-working. At first it seems curious that he should have been so long learning to manufacture iron, for iron ore is much more widely spread in nature than either gold, copper, silver, or tin, but we must remember two things:

1. The first is that iron ore is not so easily seen as bright gold nuggets or silver or some copper ores.

2. The second is that iron needed a new method of working. Copper was easily melted and could be run into a mould. Iron needed much more heat, and the ore could not be made hot enough to cause the iron to melt and run out into a mould.

Probably the first men to find out how to cast iron lived somewhere near the south coast of the Black Sea. Then, in time, the knowledge spread all over Europe, and the people who used iron swords and daggers conquered those who still used bronze: a bronze sword or dagger was much softer and much less deadly than one of iron.

A new discovery always takes time to spread. In the early stages only a few nations, and only a few people in those nations, are able to afford to make use of it. In the Copper and the Bronze Ages, for instance, many people had to go on using stone, though they often tried to make things of the same shapes as the newer metal tools and weapons. Many countries did not learn the use of iron for a long time, while in other countries some men went on using bronze because iron was still scarce.

In time, however, most men gave up the use of tools and weapons made of stone, copper, and bronze for others made of

[London Museum.

Ancient Britons of the early Iron Age.

iron, and the Iron Age began. Because iron is the most widely used metal even of our own times, we may think of ourselves as still living in the Iron Age. Moreover, the Iron Age has now lasted so long that to-day iron goods are obtained by the poorest people and by those in the most distant lands.

If we want to know what the early manufacture of iron was probably like, we can get an idea by watching some of the negroes of the present day at work in the Sudan in Africa.

Iron ore, in the Sudan, occurs in a layer of ironstone about ten feet below the surface. To obtain the ore the negroes dig several pits a few yards apart, each reaching down to the layer of ironstone. They then tunnel from one pit to the next, pick out the pieces of ore, and pass them back to others, who throw them up to the surface. At the surface they are placed in baskets by women, who put the baskets on their heads and trudge off to the smelting furnaces.

The furnaces are built of mud, obtained from ant-hills, and are often about twenty feet high, so that there may be a good draught. At the base of the mud tower are several holes into which the blowers push the nozzles of their goat-skin bellows. The fuel is charcoal.

The iron smelters of the Sudan, like the copper smelters of the Katanga region, are looked upon as magicians, and they do their strange and wonderful work at night. A fire is lighted in the furnace and basketfuls of charcoal and iron ore are thrown in from the furnace top, which is reached by climbing up a notched pole. When the clay of the furnace is hot the blowers begin their hard work on the bellows: the fire roars, the sparks fly, and the metal collects in the base of the tower. It is raked out through one of the openings.

The heat from these simple furnaces is not great enough to melt the iron completely. The metal merely forms a spongy mass, which is mixed with ashes and charcoal.

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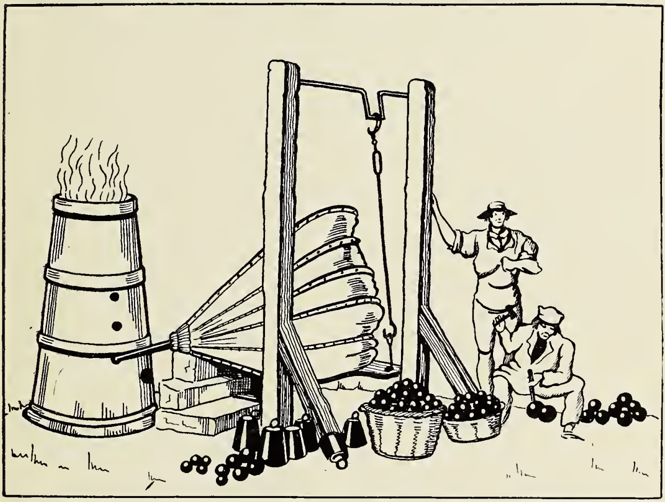
The mud furnaces of the iron smelters of the Sudan.

In much the same simple kind of way was the first iron worked and smelted in England. Ironstone was mined and smelted and iron weapons were being made before ever the Romans landed on British shores. In those days, and for several hundred years afterwards, the chief iron-working districts were in the Weald of Kent and Sussex, and in the Forest of Dean between the rivers Severn and Wye. Each of these districts contained both iron ore and forests whose timber supplied charcoal for the smelting furnaces.

In the early days the iron was smelted quite close to where the ore was being dug. At first the ore was obtained from an open quarry, but, as the surface ironstone became used up, the miners had to dig deeper down into the earth. They did their work with a short pick about the size of a hammer, and they placed the lumps of ore into wooden hods, which they carried on their backs. They worked by the light of a candle, which was stuck either on the wall of the mine or was carried on a wooden stick which the miner held between his teeth. The furnace was at first a pit about four yards long, three yards

wide, one yard deep. It was placed high up on a hill top so that the wind could give plenty of air for the fire. From the bottom of the furnace a tunnel was made to the hillside to catch the wind. A fire was lighted in the pit, and charcoal and ironstone were added until it was full. The wind roared through the tunnel, the fire burned, and the metal was melted out of the ore and collected at the bottom of the furnace.

The early iron-workers of England met with the same difficulty as the present iron workers of the Sudan. They could not heat the ore enough to make the iron melt so that it could be poured into a mould. All they could do was to hammer the spongy mass with heavy wooden mallets into a solid lump and then to shape it by further heating and hammering.



An early English iron foundry. The furnace on the left is kept alight by the giant bellows, and is casting iron cannon balls.

As man grew wiser he learned to use wheels driven by water to work the heavy hammers and also to blow the bellows.

A tremendous amount of timber had to be cut down to supply charcoal for these iron furnaces. Whole forests were destroyed, and a great outcry was raised throughout the country. This made the iron-masters try to find another fuel to take the place of charcoal. Coal was first used and then coke. Coke was such a good fuel that charcoal was employed less and less and the forests were saved.

Coke is made from coal, and it so happened that, in England, the coal for the coke and the iron ore for the iron were close together, so that a new iron industry grew up on the coal-fields. After that the Weald, as a smelting district, lost its importance.

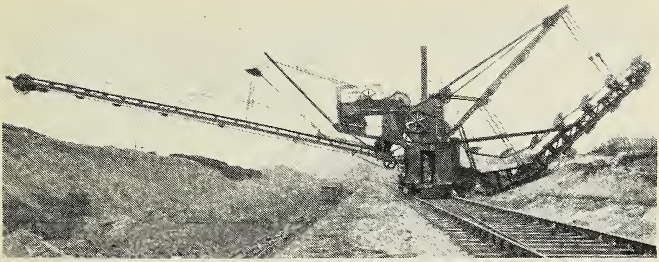
For a long while the great difficulty of the iron-workers was to raise a blast of air powerful enough to make the coke burn strongly, but soon after James Watt introduced his steam engine, in 1786, a blowing engine, driven by steam, was invented, and the trouble was over.

The making of iron went ahead by such leaps and bounds that it was not long before some of the ores were used up, and the iron workers had to look for fresh ores elsewhere. The chief areas in Britain that now supply iron ore are:

1. The Cleveland Hills in the north of Yorkshire. Here the surface ore has all been used, and the ironstone is now obtained mainly from underground workings. The ore is broken down by dynamite and the fragments hoisted to the surface by winding machinery.

2. Near the coast in Cumberland and North Lancashire. The ore here is also obtained from underground workings. The chief centre of the industry is Barrow-in-Furness.

3. A third very important area is along a line from North Lincolnshire through Leicestershire and Northamptonshire



[Courtesy, Appleby Frodingham.

A steam-shovel at work in Lincolnshire.

into Oxford. The ore bed here consists of an easily worked sandy substance which lies quite near the surface, so that there is no need to sink deep mines. The miners work as if they were digging a canal. A railway line is laid down and a large steam-shovel removes the overlying earth. Then the iron ore is shovelled up and carried away in trucks to be smelted.

Five other important parts of the world that produce iron ore are: (1) Lorraine, in north-eastern France; (2) the United States, near Lake Superior; (3) Russia; (4) Sweden; and (5) Germany. More than a quarter of all the iron used in the world is mined in France, and nearly another quarter in the United States. Most of this ore is smelted in the countries where it is mined. We, in England, get our imported supplies mainly from Spain, Algeria, Sweden, and Norway—countries which have practically no coal to smelt their iron ore.

EXERCISES

1. What advantages had the Weald, in former times, for the manufacture of iron goods? Why has iron smelting been given up in this region?

2. Write down the names of the three most important iron-mining regions of England and Wales. Mark them and name them on a map.

3. On a map of the world mark and name the following important iron-mining regions: Minnesota (U.S.A.), Lorraine (France), Cantabrian Mountains (Spain), Sweden—north of the Arctic Circle.

CHAPTER 6

MAN FINDS COAL

WHO found out that coal would burn? No one knows. The earliest mention of the use of coal for heating is in a Greek work written about four hundred years before Christ, and it must, therefore, have been then in use for some time. We know too that in Britain the Romans used it, to some extent, for cinders have been found in the ruins of their fire-places. Yet, after the Romans left the country, the coal of Britain seems to have been long neglected or forgotten.

Coal occurs in more or less horizontal sheets or seams between layers of hard rock, something like meat in a sandwich. In places these layers come to the surface. The earliest coal-miners had no idea that the seams stretched for miles underneath the ground, and they dug for coal only where they could see it.

Later, they made a shallow kind of mine. They dug out a narrow pit as far as the coal seam, and then widened it out at the bottom till it had a shape something like that of a hand-bell. They knew nothing about propping up the roof with timber, and had to leave off mining when the rock over their heads looked as if it were likely to crash down on them. They then dug a fresh mine about thirty or forty yards away.

The coal was loosened with a pick, shovelled into baskets, and wound up to the surface with a windlass.

For a very long time coal could be used only near to the place where it was mined. There were no railways or motor lorries, and the country roads were too bad for wagons. The usual way of carrying goods was on a pack-horse, and this was not at all suitable for such heavy stuff as coal. Towns on the coast, however, were well supplied, and in the time of Henry

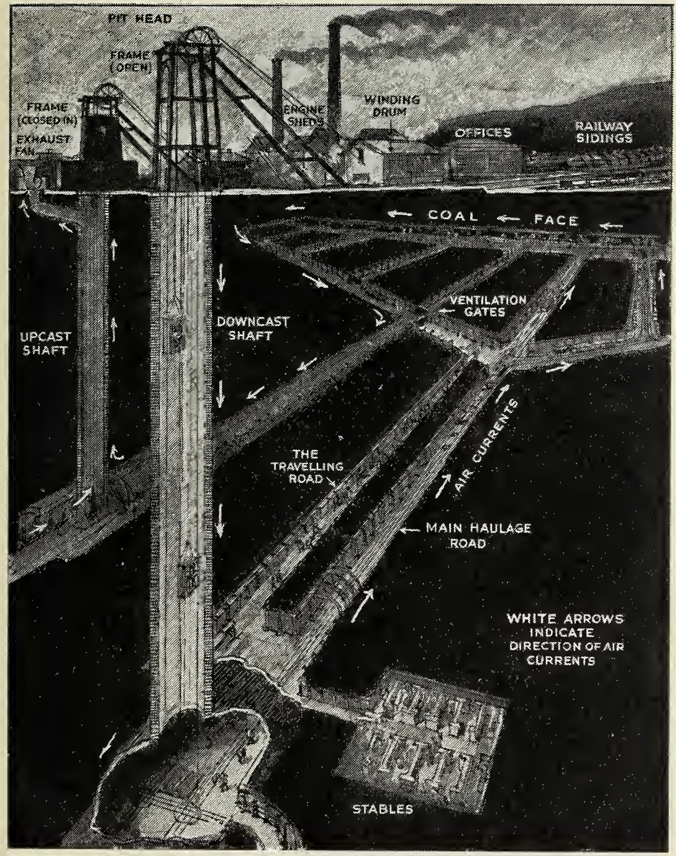


Diagram of a section through a coal-mine, showing the pit buildings and machinery, and the workings underground.

VIII a fleet of two hundred sailing ships regularly carried coal from Newcastle to London.

For hundreds of years coal was used only for heating and cooking, and the demand for it was not, as we should now think, very great. But when it was needed for smelting ores and driving steam-engines, the demand became tremendous, and the miners had difficulty in raising all that was needed.

At the present time coal is mined at great depths. Some of the pits, or shafts, go down more than half a mile below the surface. Digging such a shaft costs a lot of money, and before the work is begun holes are bored right down to the coal to see if the mine is likely to pay. By means of the earth that is brought to the surface, it is possible to say how thick the coal seams are, how deep they are, and what is the quality of the coal.

If the results of the boring promise a good mine the miners begin to dig a shaft. As the coal seams are seldom quite horizontal, the shafts are usually sunk towards the lower end of the seam. This helps in the drainage of the mine, because the underground water will run down to that level when the seam is opened. It also helps to make mining easier, because when the trucks are filled they will be going downhill when they are sent to the bottom of the shaft.

The shaft is sunk right through the coal seams, and even a little farther so as to make a well, or *sump*, where water can collect.

All coal-mines must have two shafts to obtain a good current of air through the workings, and when the coal is reached a tunnel is dug from one shaft to the other. Modern pits are thoroughly well ventilated by powerful electric fans that draw air through all the underground passages.

When the shafts are finished, several main roads are cut, in different directions, through the coal seams, and narrow

[Courtesy, Coal Utilisation Council.

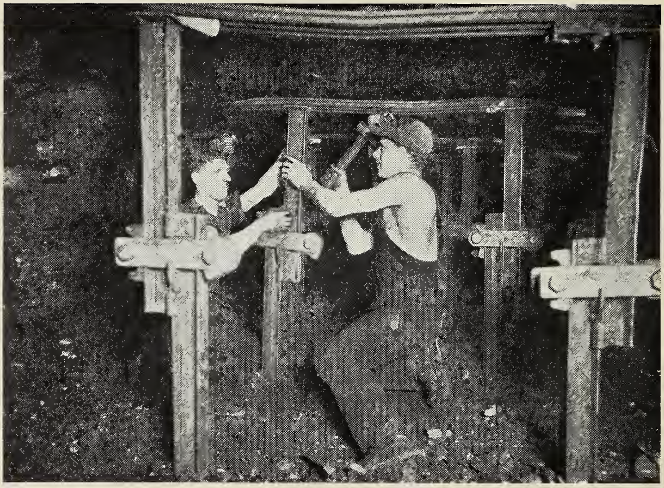
A miner boring shot holes for blasting.

tramlines are laid down. Then the real work of "coal winning" can begin and many men can be employed.

A miner's tool is either a pick or an electric coal cutter. If he is using a pick he generally has to kneel or lie on his side, for he has to cut a long and deep groove underneath the coal. As he cuts away, in this uncomfortable manner, he has to prop up the coal roof with pieces of timber, called pit props, to prevent it crashing down on him. When he has cut several yards in this way he removes the wooden props, and with his pick or with an explosive he breaks down the heavy mass of unsupported coal.

As he goes farther away from the shaft a safe road is made behind him by supporting the roof with pit props or iron girders or by building two strong stone walls.

Along these alleyways a belt, shaped like a trough, is kept



[Courtesy, Coal Utilisation Council.

Setting steel props to support the roof.

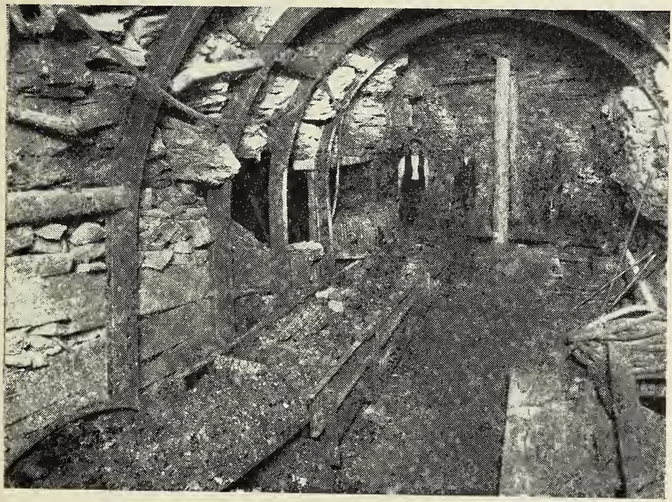
moving to carry the coal to the tramway on the main road. The miner shovels the coal behind him on to the belt, and away it goes on the first part of its journey towards daylight.

When the coal on the moving belt reaches the main road, it is emptied into trucks, or *tubs*. When half a dozen or more of these have been filled they are put in the charge of a boy, who sees them along to the bottom of the shaft. In some of the older mines the haulage is still done by ponies. In others an endless cable is always being drawn over grooved rollers throughout the workings, and the train of trucks is just hitched on. Small electric engines are used in a few mines. This method is very much quicker, and the engines, too, can be used to carry the men to and from their work, thus saving

time and the fatigue of trudging through a mile or more of dismal passages.

At the bottom of the shaft are the general stores, the pump-room where an electric turbine pumps the water from the sump to the surface, the power-house where electric motors keep the cable moving throughout the mine, and the stables, if horses are used. Here, too, there are several tramway sidings, with a score or more of full trucks ready to be lifted to the top.

The lift is a kind of cage, frequently with two decks. Four trucks are hauled on to each deck, the gates are closed, the signal bell is rung, and thirty tons of coal are rushed up the shaft to the surface at great speed. All day long the engine-



[Courtesy, Coal Utilisation Council.

Face conveyors, seen between the steel props on the left, delivering coal on to the main conveyor.

man above works the powerful winding engine that hauls one cage up and sends another down.

At the top of the mine are two great pulley wheels mounted on tall steel or concrete supports and the engine-room that supplies power for the lift and electricity for the fans and pumps and for the underground haulage.

There is plenty of work to be done on the surface before the coal is sent away. The trucks are tipped upside down on to sifters, where the coal is graded according to its size. Then it goes on to a belt and, as it passes along, men pick out any lumps of stone which will not burn. Finally, the coal is washed.

EXERCISES

1. Write a few lines about the work of Sir Humphry Davy, Thomas Newcomen, and James Watt.

2. On a contoured map of England and Wales colour all the land under six hundred feet green and all over six hundred feet brown. Mark in ink the coal-fields mentioned in the next question. What do you notice ?

3. Copy the following list of British coalfields in your note-book; fill up the remaining columns as you read the rest of this book.

British coalfields	Chief towns	Chief industries
South Wales		
Northumberland and Durham .		
Cumberland		
South Lancashire . . .		
West Riding		
South Staffordshire . . .		
North Staffordshire . . .		

4. Why was the Northumberland and Durham coalfield the first one to become important for sending coal to London ? What advantages has it now for exporting coal easily ?

5. On a contoured map of Europe colour all the land under six hundred feet green and all over six hundred feet brown. On this map mark in ink the chief European coalfields:
   (*a*) The Ruhr coalfield, around the river Ruhr (Germany).
   (*b*) Saxony (Germany).
   (*c*) Along the northern edge of the Ardennes from Lille (France) to Liège (Belgium).

What do you notice ? Name one town on each of the coalfields.

6. The most important coal-mining region in North America is in Pennsylvania (U.S.A.). Find this coalfield in your atlas. What do you notice about its position with regard to the high land ?

PART TWO: THE MANUFACTURERS

CHAPTER 7

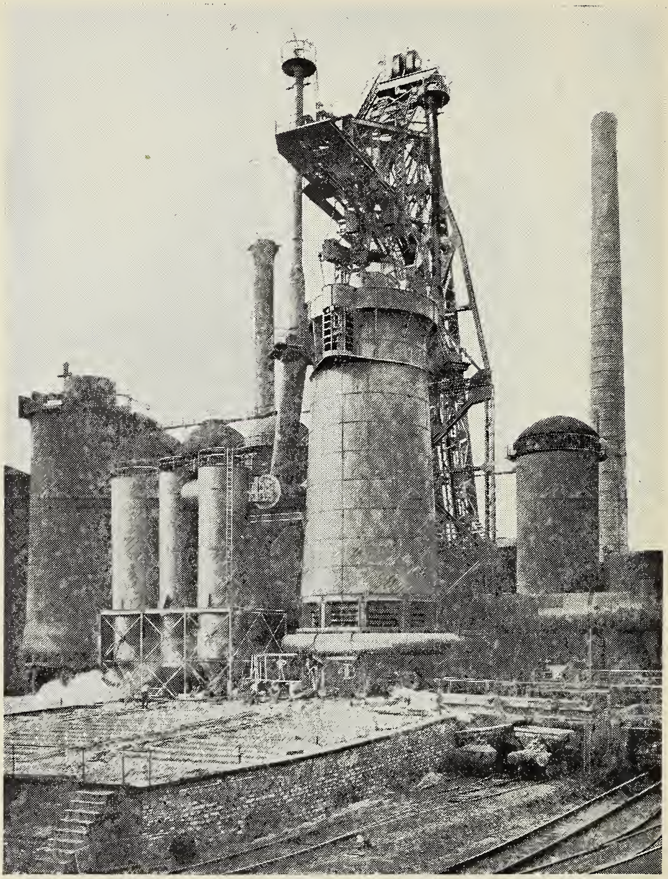
THE STEEL MAKERS

IN Chapter 5 we saw how the negroes of the Sudan make iron at the present time and learned something about the early history of making iron in England. In this chapter we are going to look at a modern ironworks at Middlesbrough, in the north of Yorkshire. We want to know how iron ore is smelted in England, and what is done with most of the iron after it has been made. We may add that the same kind of work is carried on in South Wales, in north Lincolnshire, at Barrow-in-Furness, and other places in Britain, and in the countries mentioned in Exercise 4 at the end of this chapter.

As in the case of the negro smelters, the first thing is to obtain the ore. The ore used at Middlesbrough comes, mostly, from mines a few miles south in the Cleveland Hills, from the open diggings in Lincolnshire and Northamptonshire, and a little, of very high quality, from the mines of Cumberland. The "iron-master" also imports a great deal from Sweden, Spain, Algeria, and other lands. He needs, in addition, coke, which comes from the Durham coalfield, and limestone, which comes from the Pennine moorlands.

The furnace is a very different kind of thing from that used by the negro smelters. It is a tall tower about eighty feet high with an outer casing of iron; inside this is a thick lining of firebricks that can withstand the fiercest heat.

The furnace is called a "blast furnace" because of the



[Courtesy, Dorman Long.

A huge modern furnace.

strong blast of air that is blown into it while the smelting is going on. The place of the negroes' goatskin bellows is taken by a powerful pump.

A railway line runs into the works; along it trains bring loads of ore, coke, and limestone. Trucks of all these things, in the right quantities, are drawn up a very steep incline to the top of the furnace and tipped into a kind of basin. The bottom of the basin is opened, and the contents hurtle into the interior of the furnace, after which the top is partly closed.

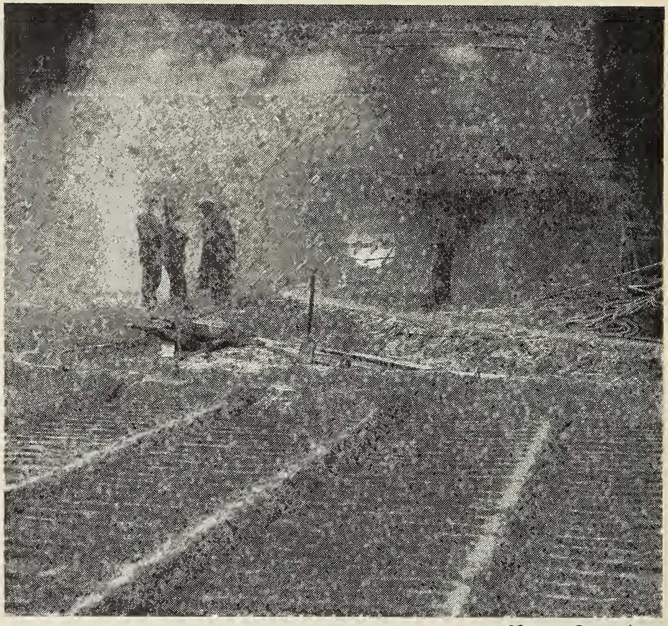
Inside the furnace the coke burns furiously, the iron melts and runs out of the ore, and the limestone unites with the impurities in the ore to form "slag." The slag is liquid, but as it is lighter than iron, it lies on the top of the molten iron. From time to time the slag is allowed to run out from a hole in the furnace into a railway truck, in which it is carried away to the slag heaps.

In front of the blast furnace there is a flat piece of ground covered with sand and divided into a large number of trenches, the smallest of which are about a yard long and four inches wide.

Every few hours a workman breaks the plug of fireclay which seals up a hole at the base of the furnace and a stream of bright, golden-coloured molten iron flows into and fills all these channels.

When the iron in the moulds has cooled and hardened, men break it into short lengths called "pigs." This "pig iron" is brittle, because it is not pure. Before it is of much use it must be changed into wrought iron or into steel.

Ordinary steel is pure iron combined with a little carbon. There are, however, many different kinds of steel, formed by adding small quantities of other substances. Some kinds are very hard, others tough; some are springy and others rigid; some are soft and some are stainless.



[Courtesy, Dorman Long.

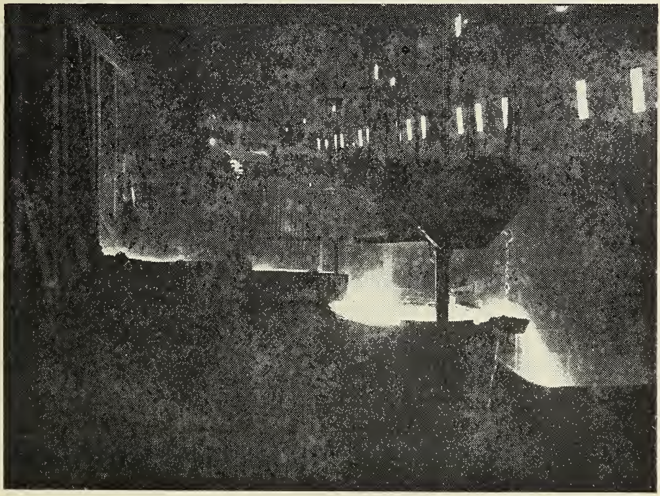
The trenches in front of the blast furnace.

There are two common ways of making steel, but the thing that the maker is trying to do is the same in each case. He wants to burn the impurities out of the pig iron and to add to the steel a certain amount of carbon and any other substance that may be needed. Most steel is now made in a kind of big oven. This is filled with iron and heated by burning a special kind of gas (not coal gas) inside it. This gas, as well as the air needed to burn it, is also strongly heated.

The oven, that is, the furnace, holds about fifty tons of pig

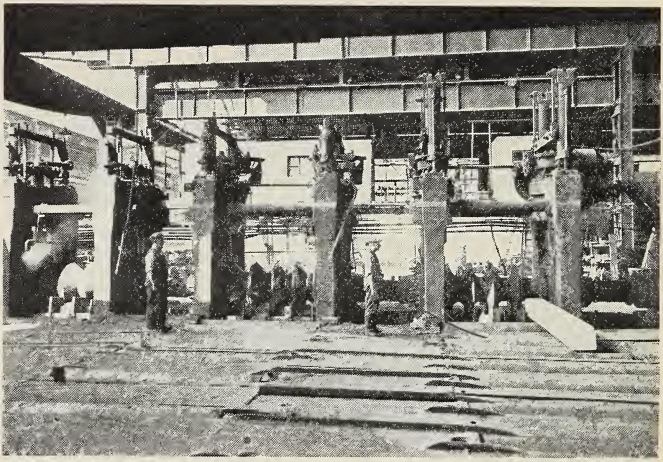
iron and scrap iron, and takes four men from two to three hours to load. The doors are then closed and the gas is turned on. After about three hours the heap of metal has melted. The doors of the furnace are again opened and iron ore is thrown in. This is stirred into the molten mass by men armed with long steel pokers. The metal appears to boil, and is kept in this condition for about twelve hours. A sample is then ladled out and taken to the chemist at the works. He tests the steel to see if it has been properly cooked.

When the chemist says that good steel has been formed, it is drawn off through a small hole that has been plugged up with clay. A man breaks the plug and out pours a stream of dazzling, bluish-white molten steel into a huge pot standing on



[Courtesy, Dorman Long.

Drawing off the steel.



[Courtesy, Dorman Long.

A steel ingot being rolled in the rolling mill.

four wheels. This pot runs on a kind of tramline and is moved along by means of an electric engine.

When all the fifty tons of steel have been withdrawn, the driver of the engine, who is nearly roasted by the heat, moves the load to another part of the building, where a number of moulds, like large drain pipes, are standing upright in a trench. The tram stops over one of these. A workman raises a trap-door in the pot, and lets out enough steel to fill the mould. The driver then moves the pot along the tramline to the next mould, and so on until all are filled.

In about fifteen minutes the steel has set. From a travelling crane which moves about, just under the roof, a chain is hooked on to each mould and lifts it off from the pillar of red-hot metal, which now is called an *ingot*. Another crane picks this up with a pair of giant pincers and carries it away to be rolled by the

rolling mill. It goes to and fro between heavy rollers, as if it were in a mangle, until it is squeezed into a steel plate, a girder, or a railway line.

The work of making steel is hot, heavy, and dangerous, but, when the furnaces and mills are busy, it goes on day and night without ever stopping. As soon as one group of men goes home for a rest, another group takes its place.

The towns in which the steel works are situated are usually rather dismal. Heaps of dirty slag lie about on the ground; there is an absence of fine trees and garden plants, for these things cannot live in the grimy, impure air; and the houses are built in long straight rows in ugly streets.

EXERCISES

1. Find out what are: (*a*) pig iron;
(*b*) wrought iron;
(*c*) steel.

2. Name the four chief smelting regions in the British Isles. Mark them on a map. From where do they obtain their coal and iron ore?

3. Find out what kinds of steel goods are made at Sheffield, Swansea, Wolverhampton, Barrow, Crewe, Middlesbrough, and Leeds.

4. Steel is also made in large quantities at Essen, in the Ruhr Coalfield of Germany, and at Pittsburg, in Pennsylvania (U.S.A.). Find these two towns in your atlas. Look in other books and find out where each obtains its supply of iron ore and coal. (See also Exercise 3, Chapter 5, and Exercise 5, Chapter 6.)

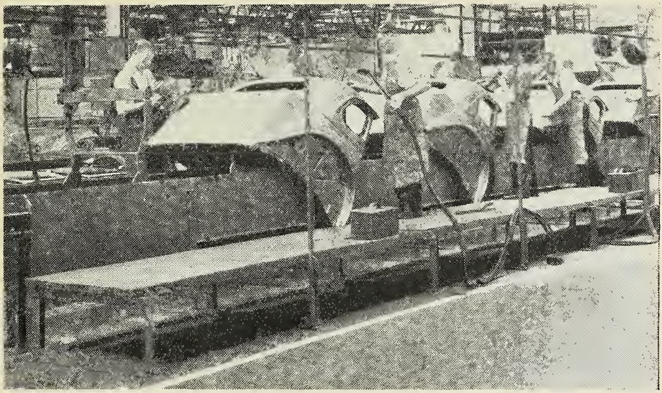
CHAPTER 8

MAKING A MOTOR-CAR

MUCH of the iron and steel that is made is used in the manufacture of machinery. Ever since man began to be civilised, he has been inventing some kind of machine or other. We now live in a time when there are machines of many sorts that are able to do a great deal of hard or tiresome work. They are found, not only in big factories, but also in our homes, where they do needlework, cut lawns, and wring clothes. They all save time and labour. Some of them can do as much work as several dozens of men, and do it, therefore, more cheaply.

Each different kind of industry needs its own special kind of machinery, and it would not be possible, even in many books, to describe them all. In this chapter we shall speak of one only—the motor-car—the machine that is best known to most people. The story of the way in which it is made shows us how modern man is trying to save time and energy and so to produce goods at a lower cost.

Some machines that are used in factories are made, one at a time, by very clever workmen, only when they are ordered. This is not so with the motor-car. Hundreds of thousands of cars are sold every year, and each one of them was made long before any motorist made up his mind to buy it. Cars are turned out, by machinery, all of the same pattern, all up to the same standard of quality, all, in fact, exactly alike in every way. In one motor works ten thousand workers are employed, and they produce one brand-new car every three minutes that they are at work. Making articles in this kind of way is called *mass production.*



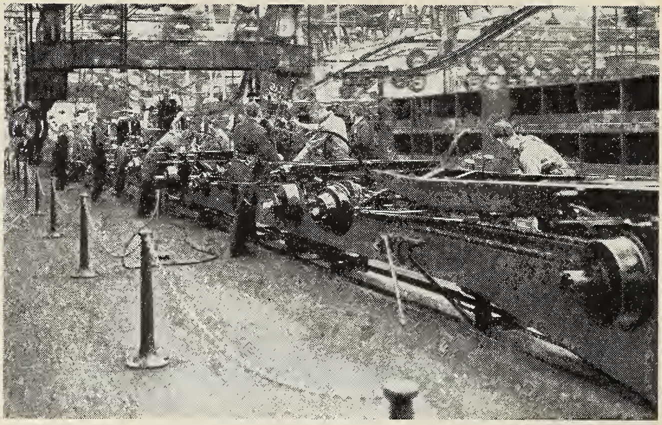
[Courtesy, Ford Motor Co., Ltd.

Men at work on the steel bodies of cars.

We have learned that, as man became more civilised, he gave up trying to do every kind of work himself. When he could, he did the thing for which he was best suited, and left somebody else to do the rest. Thus arose *division of labour*. In the making of a modern motor-car this idea of the division of labour has been carred very far.

A motor factory consists of a number of long sheds, called *shops*, which lead into a bigger one where the parts of the car are put together, or assembled. The work flows through these rooms almost as smoothly as water flows along in a river.

At one end steel plates and pig iron arrive from the iron-works. The pig iron is taken to the *foundry*, where it is changed into steel and cast into back axles, cylinder blocks, and other heavy parts of the car. These then travel into one of the *machine shops*, where lathes, turned by machinery, pare off fine steel shavings and make the parts perfectly true in every way.



[Courtesy, Ford Motor Co., Ltd.

The long main assembly room.

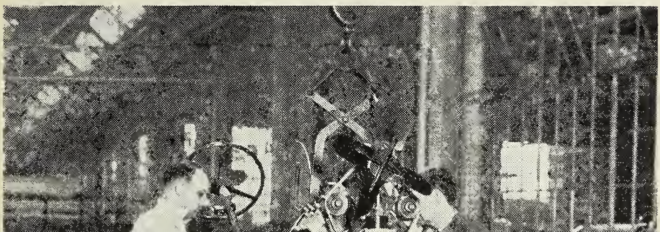
The steel plates go to another shop, where massive presses bend them into shapes that form the body of the car. In another of these noisy sheds smaller presses stamp out the lighter parts, such as petrol tanks, silencers, and luggage carriers. In yet another shop blacksmiths are at work, but they do not use either hammers or anvils. The red-hot metal is moulded into shape by a heavy weight falling on it from a height of several feet.

In each of the side shops a part of a car is completely constructed and thoroughly tested. In one of them the engine is made and examined to see that it can perform its work properly. In others the gear boxes, radiators, axles, and bodies are formed and tested so that not even the smallest fault can pass unnoticed.

The long assembling shop is, perhaps, the most interesting part of a motor works. We can think of it as the main river to

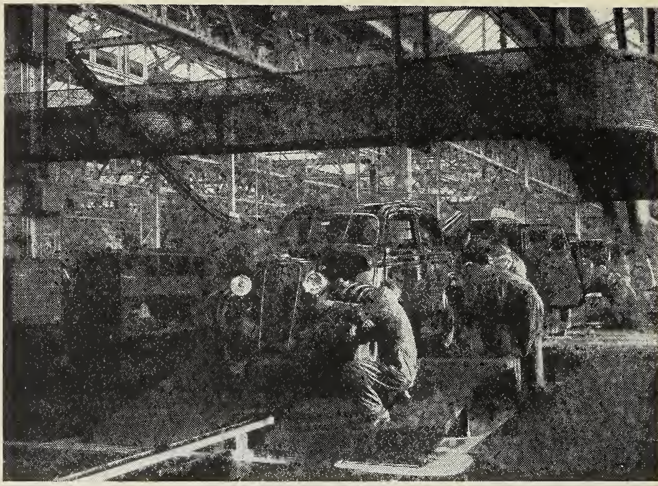
which all the other shops are tributaries. A steel track runs along its whole length. Whatever is placed on this track travels slowly forwards.

First comes the steel framework, which forms the under part of the car. As it moves along, different men fix to it the axle, springs, and wheels. There is very little need for the mechanics to move far while they are at work. They do not have to waste time fetching tools or looking for the things they need. Their special task and everything required to complete it comes along just when it is wanted. Each man



[Courtesy, Ford Motor Co., Ltd.

An engine being placed in a chassis.



[Courtesy, Ford Motor Co., Ltd.

The completed cars leaving the assembly shop.

has his own special place and a certain time in which to perform his task.

In time the framework is ready for the engine. This is lifted by a crane, lowered into the right position, and fixed to the frame. It is then taken over by other groups of mechanics, who fix the gear box, radiator, steering wheel, and brakes. Everything is splendidly timed so that there is no waiting, and, on the other hand, nothing has to be done in a hurry.

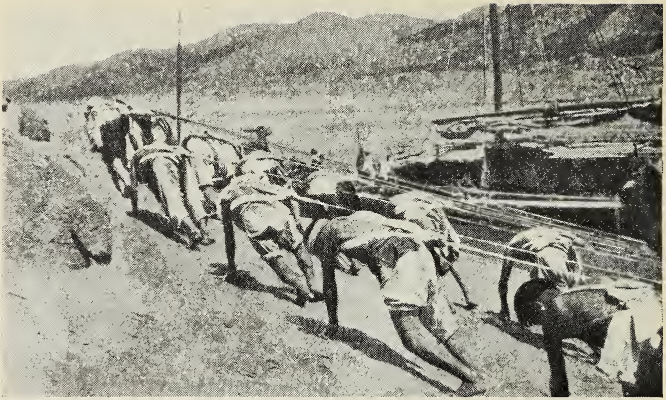
Opposite the *body-building* shop a complete body, brightly painted, and with the seats in place, is dangling at the end of a chain. It, in its turn, is gently lowered into position and safely fixed. Then the bonnet, the lamps, and even the mascot in front are attached.

When the car reaches the end of the factory, petrol is poured into the tank, and the car, under its own power, runs round the *testing track* to see if the engine is properly working.

The motor-car industry is a new one, and shows us how man is advancing. Not only is there more division of labour, more clever machinery and less sheer hard toil, but the cars are made in more pleasant surroundings. As a rule the factories are well planned for the health and comfort of the men who spend their time inside. Most of them have their own sports clubs and sports grounds. One factory has its own well-fitted hospital and a school where the young apprentices learn a number of interesting things besides the right ways of handling tools and looking after machines.

EXERCISES

1. Make a list of the names of as many motor-car manufacturers as you can, and opposite each name write the name of the town where the factory is situated.
2. Try to think of five different things in the making of which no machinery is used.
3. Make a list of the following machines, and opposite each write the name of a town where they are made: threshing machines, bicycles, railway locomotives, steam rollers, engines for liners, cotton-weaving machinery, sewing machines, and watches.



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Men on the banks of the River Yangtse-kiang hauling a boat.

CHAPTER 9

POWER

ALL machines need power to make them work. The first machines were levers, rollers, and pulleys, but the only power that was known to man was *human strength*. All heavy work, like building the pyramids in Egypt, was tiresome and slow, even when large numbers of men were employed.

The next form of power to be used was the *strength of animals*. In Southern Europe bullocks are still employed to draw ploughs and country carts, while the people of South-east Asia make use of the water buffalo. Elephants in Siam and Burma and bullocks in Western Australia are employed to haul fallen timber out of the forests, while dogs, to this day, can be seen in Belgium and Switzerland harnessed to light carts.

Man next made use of the *wind*. On the sea he fitted sails to ships. Before that happened the only way to move a boat was to row it, and some of the Roman galleys had crews of as many as 100 slaves. The sail was much better than the oar, because it saved human toil, but it was not, at first, as useful as it afterwards became. It took several hundreds of years for man to learn how to sail a ship against the direction of the wind.

On the land man made use of the wind by means of a windmill. A few windmills, for grinding grain, are still to be seen in England, and here and there are wind-driven pumps that raise water from deep wells. In Holland windmills are much more common, but they are now giving way to pumps worked by engines that are driven by other kinds of power.

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An elephant hauling timber in Burma.

Then man learned how to use the force of a rapidly flowing stream, that is, *water power*. The water was made to flow over, or pass under, a paddle wheel and force it round. It was in this way that the early iron-masters worked their bellows and their heavy hammers. A few water wheels are still in use for the grinding of grain in country districts in England. In the small but rapid streams flowing through the forests of Norway, water wheels are commonly used to work circular saws for cutting up tree trunks into suitable lengths.


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A windmill in Holland.

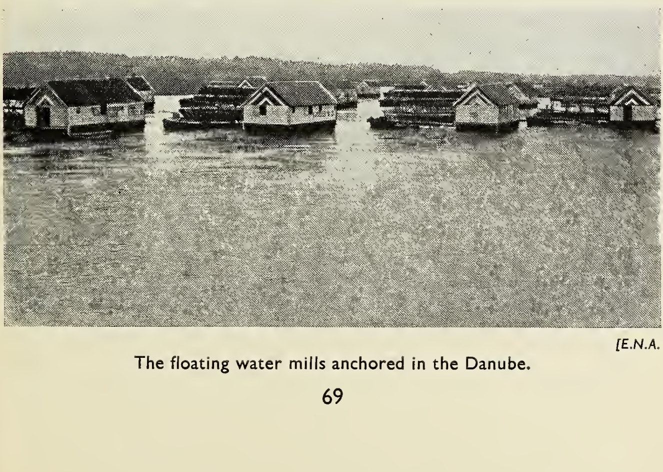
Water power in some ways was better than wind power. The wind sometimes stopped blowing, but the streams, as a rule, flowed from one year's end to another. On the other hand, windmills could be used on the plains where people usually like to live; the water wheels had to be placed where the streams were rapid, and these were often amongst the hills and mountains, where living is not so easy. Big rivers, as a rule, flow too slowly to work wheels, but the farmers of Hungary are able to grind a certain amount of grain in float-

ing water mills that are anchored in the rapid current of the river Danube.

A great change and a great advance was made when James Watt improved the steam-engine and made it possible to drive machines by *steam.* Big factories were then built on the coal-fields, and took the place of the small works and mills that were dotted along the river valleys. When railways too were made, coal could be carried to parts of the country far from the coal-fields, and steam power soon took the place of all other forms of power.

In some countries, where coal is scarce, steam power is obtained by burning wood. The trains of the Trans-Siberian Railway, which run right across Asia from the Ural Mountains to Vladivostok, are drawn by steam-engines that burn wood from the great forests of Siberia.

To-day some countries use a great deal of electricity that is made with the help of falling water. The new power produced in this way is called *hydro-electric power.* It has been of great value in mountainous countries, where there is not much coal



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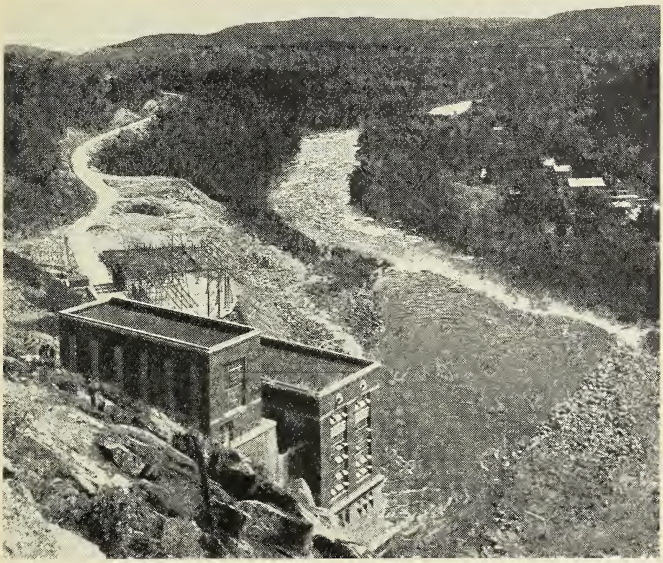
The floating water mills anchored in the Danube.

or none at all. The waterfalls and the rapids, instead of running to waste, are now used to drive machines that turn the water power into electric power. The place where the change from the one kind of power to the other takes place is called a hydro-electric power station.

A hydro-electric station is usually in a very quiet place, for it is generally in the midst of some wild and lovely area where there are few people except those at the station. There is very little to be seen except the power house and a number of pipes through which water pours down from some lake, reservoir, or waterfall to drive the engine that makes the electricity.

Electric power is growing in importance every day. Unlike coal, it does not blacken the countryside with dirty smoke and, again, unlike coal, it can easily be sent from the place where it is made to the place where it is used. It costs so much money to carry coal over long distances by train that, in the past, all the big factories, all over the world, have been built on the coalfields. Electricity needs no trains. It can easily travel along wires, and the factory need not be in the mountains close to the power station. It can be down in the plains, where live the people who use electricity for lighting and heating their houses and for cooking their food, as well as for driving machines in factories.

Naturally, hydro-electric power is most used in countries where there is plenty of falling water, especially if these have little or no coal. At the present day the force of the streams in the Alps provides electricity for several industries carried on miles away in the northern part of Italy and also for most of the railways in Switzerland. The basin of the river Garonne, in Southern France, is crossed by several lines of cables and pylons bringing electricity northwards from the power stations in the Pyrenees, while most of the large saw-mills in Sweden, Norway, and Finland are now worked by hydro-electric power.



[Ewing Galloway, N.Y.

An American hydro-electric station on the Sacandaga River.

The countries where this power is most developed are the United States of America and Canada. The mighty falls of Niagara, together with some smaller, but still large ones, both in the western highland and in the eastern parts of the continent, are now used to produce large quantities of this cheap, clean, useful form of power.

In the British Isles there are, unfortunately, few large waterfalls or powerful rapid streams. Near Loch Ness, in Scotland, the water of the Falls of Foyers provides power for the making of aluminium, and there are other small hydro-electric stations in other parts of Scotland, in Wales, and in the Lake District.

In recent years much progress has been made, in Britain, in carrying electricity to many parts of the country, but this electricity is not made by falling water but by burning coal, which is abundant and cheap.

When the supplies of coal begin to dwindle, some other means of producing electricity will have to be found. It seems likely that water power will have to be used, but it will not be water in rushing streams, but that of the tides that ebb and flow twice a day round all the British shores.

EXERCISES

1. State one purpose for which each of the following means of power is used: (1) Man's muscles; (2) Animal's muscles; (3) Wind; (4) Water; (5) Steam; and (6) Oil.

2. State clearly the advantages and disadvantages of: (1) A corn mill driven by steam, coal, or water. (2) A locomotive driven by steam or electricity.

3. Why is electricity so cheap and so commonly used in Norway or Switzerland compared with what it is in parts of eastern England?

4. If the electric power obtained from running water in various countries were evenly distributed amongst the inhabitants, we should obtain the following table:

	Average horse-power that could be used by a group of one thousand people.
Norway	740
Canada	485
Switzerland	437
Sweden	266
U.S.A.	97
France and Germany, each	63
England	Nil

(*a*) Look at a relief map of these countries, and try to find out why water power is so well developed.

(*b*) One horse-power in a year can do the same amount of work as six tons of coal. How many tons of coal does each person in Norway save in a year by using hydro-electric power?

5. Suggest an explanation why Norway and Switzerland are such clean countries.

CHAPTER 10

PETROLEUM

WE have seen men living in the Old Stone Age, the New Stone Age, the Bronze Age, and the Iron Age. The last century might almost be called the Coal Age, for, without the coal, there would have been none of the factories and the industries of that century. This century might perhaps have two names—the Age of Electricity or the Age of Petroleum or Oil.

We should be very badly off at the present time if we had no petroleum. It provides paraffin, which is still burned in lamps in some places, to give light ; it provides thick oil with which to grease our machinery and make it run smoothly; it is burned as a fuel in many ocean liners; and from it is made the petrol with which we run our motor-cars and aeroplanes.

Petroleum is a mineral oil, found, like coal, deep down below the surface of the earth. It was formed by the decay of plants that lived and died millions of years ago. It collected, as a rule, in layers of sand between beds of other rock through which it could not pass. Sometimes these layers of rock, below the surface, lie in big wrinkles like the hills and valleys that we see on land. Water collects in the lower part of the porous bed; the lighter oil floats on the water, and is forced up near the top of the wrinkle. If it can find a crack it slowly oozes upwards, but, if there is no way out, it has to wait until some lucky oil prospector finds it, sinks a well, and allows it to rise or else pumps it to the surface.

Although we say that we are now in the Oil Age, that does

not mean that petroleum has only just been discovered. It was known thousands of years ago, long before coal was commonly used. In former days supplies of petroleum were obtained from oil springs in places where they oozed up to the surface. Later on, in some places, men learned that it could more easily be obtained by digging shallow wells.

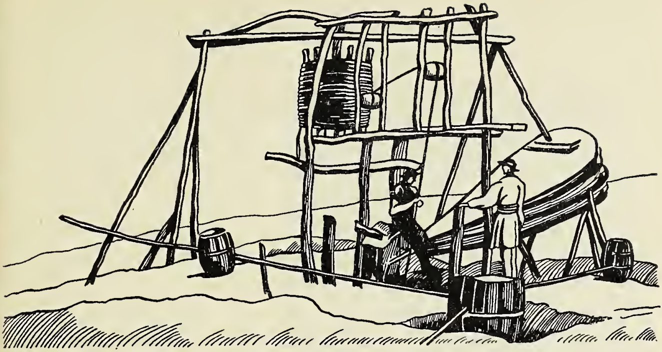
In this century there is such need for petroleum that all parts of the world have been searched for it and, at the present time, men are looking for it, even in Britain, where little has as yet been discovered. The methods of obtaining petroleum have been much improved to meet the huge demands of modern industry.

Rumania, in Europe, is an important oil-producing country. We can there see oil being obtained in the same old way that has been in use for centuries, as well as by those more modern methods that are employed, all over the world, wherever oil is obtained in large quantities.

Let us look first at the old method. A few peasants agree to share the work of digging a well and to divide the profit made by the sale of the oil. The wells are about five feet across at the top, and go down, sometimes, as much as five hundred feet. In the narrow hole each man takes it in turn to dig for three hours at a time. Another man attends to the windlass on the surface and winds up the buckets of earth as fast as the digger fills them.

As the digger works downwards he encases the sides of the well with small branches or wickerwork to prevent the sides from breaking away, and he generally wears a steel helmet to protect his head against falling stones. Water collects rapidly in the well, and he has to be constantly bailing it up and sending it aloft in the bucket. When he is hauled up he looks a sorry sight, for his body and the small amount of clothing that he wears are plastered over with mud and sometimes smeared with oil.

At so great a depth below the surface it is quite dark, and as it would not be safe to carry a lantern, sunlight is reflected



An old method of obtaining oil.

downwards by one or two tilted mirrors at the surface. The workers need fresh air as well as light. Sometimes the air is stirred up by dangling some leafy branches in the hole and moving them up and down, and sometimes air is forced down by large bellows, but neither method is very good.

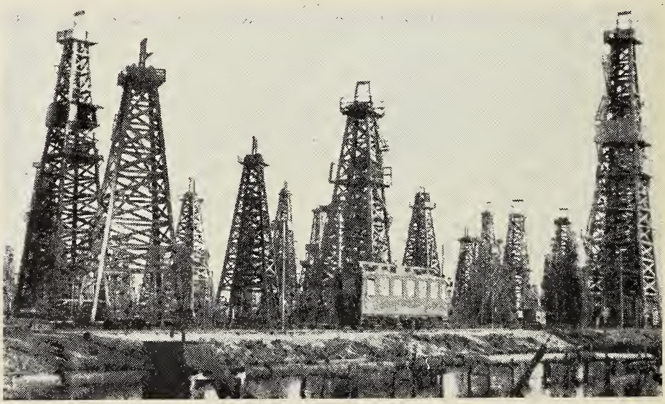
When the oil is reached, the work becomes really dangerous, for the digger is likely to become gassed by a sudden outburst of petroleum fumes. On this account he generally works at the end of a rope, so that he can be wound up at the first signal of distress.

A well of this kind may take about two years to dig. When a good supply of oil is reached digging is stopped, but work continues on the windlass. The oil collects in the well and is raised to the surface either in barrels or in large skin bags. Many of these hand-dug wells produce twenty tons of petroleum a day.

The modern method of obtaining oil is not to dig a well, but to bore a hole. If one goes to an oilfield at the present day, one sees dozens of towers, each about fifty feet high. Each

of these *derricks*, as they are called, marks the position of a boring. The search for oil has, in some places, been so keen that half a dozen derricks may be seen on a piece of ground no bigger than a football pitch.

The derricks are built to support the tools used in boring for the oil. A rope is passed over a pulley at the top of the derrick, and on it is fastened a huge semicircular chisel, called the drilling bit, which may weigh more than a ton. The rope and the bit are hauled up several feet by an engine and then released. The chisel plunges downwards and cuts a hole into the ground. It is then heaved up and allowed to fall once more, and so the work goes on until the boring perhaps reaches a depth of several thousand feet. Every now and again the pieces of rock that the bit has chipped off are flushed out of the hole by a water pump. To prevent the sides slipping in, a pipe is dropped into the hole, and as the boring goes deeper and deeper fresh sections of piping are screwed on to the top.



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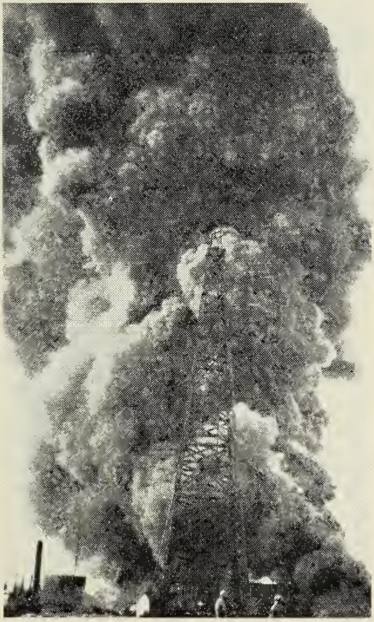
Derricks on a modern oilfield.

When the oil is reached it may force its way up the pipe to form a terrifying fountain, called a *gusher*, or it may only just ooze lazily over the top. In the former case it sometimes catches fire from the engine furnace, and thousands of pounds' worth of good petroleum may continue to go up in smoke for days.



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A gusher on fire.

After the oil is "struck" the owners have to make a tank to hold it. One would think that this would be done first, so that none need be wasted, but oil searchers do not like counting their chickens before they are hatched, and they are never sure, if they are working in a new area, if there is any oil below them or not. When they succeed they telephone to one of the big oil firms, who rush loads of iron plates and rivets to the spot, and within five days a huge round tank is built which looks like the gas holders seen in the gasworks.

The petroleum has to be taken to the people who need it. It is carried in tanks on railways, or in ships called *tankers* that are specially built for carrying oil, but perhaps the commonest

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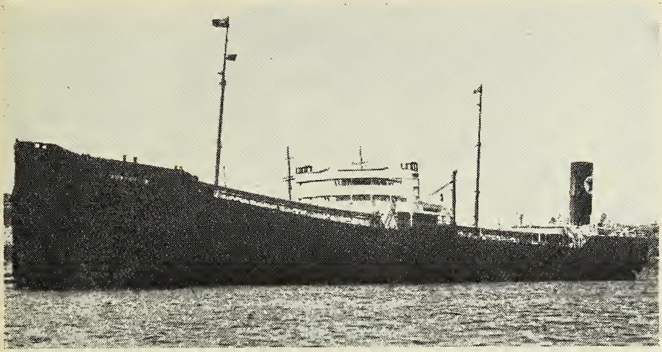
Laying pipes to carry oil from the oilfield to the refinery.

method is to run it through pipes, just as we do water. By one means or another it arrives at some place, where it is purified, or refined. When it comes to the surface it is a thick, heavy, brownish-black liquid. At the refinery it is treated in tall steel towers in such a way as to split it up into the many useful things it contains—petrol, paraffin, lubricating oil, vaseline, paraffin wax, and asphalt.

As we have said, little petroleum has yet been found in the British Isles. Our supplies are brought, in tankers, chiefly from the United States of America, which contain the greatest supplies of oil in the world, from Russia, Venezuela, Persia, and a few other countries. Recently chemists have discovered how to make petrol from coal, and a large factory has been built at Billingham in Durham for this purpose. It is doubtful, however, whether we shall ever be able to supply all our needs with home-made petrol. We now import hundreds of millions of gallons for our motor-cars, lorries, and aeroplanes; these could not very well be driven by coal. For ships, too, petrol-



[Fox Photos.

An oil tanker.

eum is greatly used, because it is so easy to handle. One giant ocean liner needs eight trainloads of coal each time she crosses the Atlantic. This means a great deal of hard and dirty work, and work costs money. It is easier, cleaner, and cheaper to run a pipe into the ship and fill her fuel tanks with oil.

EXERCISES

1. Name the chief products that are obtained from petroleum, and briefly describe their uses.
2. Find out how oil is formed in the ground.
3. What are the chief advantages of oil for use in transport by (1) land, (2) sea, (3) air ?
4. There are many different kinds of oils and fats. Write down the name of one oil or fat obtained from each of the following, and say for what purpose it is used: small seeds, nuts, fish, animal flesh, a fruit that grows round the Mediterranean Sea, and milk.
5. The following are the chief petroleum-producing countries, with the amount, in million tons, that they produced in 1934:

Texas	51	U.S.A. 122	Venezuela	20
Oklahoma	24		Rumania	8
California	24		Persia	8
Other States	23		East Indies	6
Russia		25	Mexico	6

World's total, 209

Mark these places on a map of the world.

CHAPTER 11

THE SHIPBUILDERS

IT is clear that large quantities of many kinds of things must be carried across the seas; for this purpose ships are needed. How and when were ships invented?

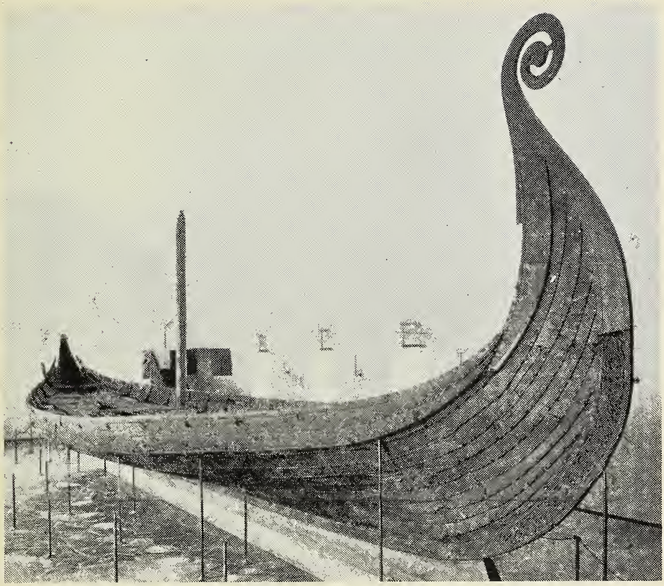
Even in the Old Stone Age man had discovered how to cross rivers with the help of a log. From that use of a single log came the idea of fastening several logs together to form a raft; rafts are still in use in many parts of the world.

In the New Stone Age man had better tools, and knew more about the use of fire. With the help of these better tools and of fire he hollowed out tree trunks and shaped canoes. Such ancient canoes, called "dug-outs," have been found with the remains of New Stone Age man; dug-outs are still made and used by some tribes of people. The natives of the islands of the Pacific Ocean made big war canoes, in which they were able to travel long distances across the sea.

In olden days boats were made of materials that could be obtained close at hand. In Egypt, where there were reeds but not trees, the river boats were made of reeds. In Mesopotamia, where pitch was plentiful, the native boats were round baskets coated inside and out with pitch; such boats are still in use on the Tigris and the Euphrates.[1] In places where men were hunters, skins were stretched across wood to make a kind of boat called a *coracle*; some coracles are still made even in parts of the British Isles.

As long as six thousand years ago there were vessels that could go out to sea. They had a high prow and a high stern, and were rowed with paddles, but were not very safe. The keel, that is, the bottom of the ship, on which the ship is built,

[1] *See* Book III, p. 13.



A boat such as the Vikings used, with a high prow and stern.

was not deep enough. When man learned that a deep keel helps to prevent the wind from blowing a ship over, he took one of the great steps forward in good seamanship. The sail, which used the power of the wind instead of man power, was another important discovery. No one knows for how long sails have been in use, but it is certain that they were employed at least five thousand years ago.

It was natural that the first great improvements in seamanship should start in the Mediterranean Sea, where there are so many islands, and that they should spread all along the western coasts of Europe.

When man began to use steam and then oil power to drive his ocean-going vessels, the deep keel was no longer so important. If you put, side by side, a picture of one of the best British sailing ships and one of a modern steamer, you can easily see the difference.

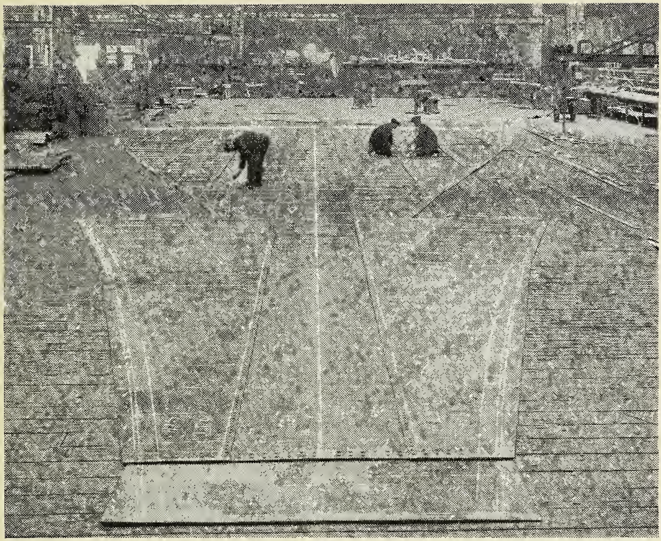
The British, like the ancient dwellers on the islands of the Mediterranean, needed to cross the sea if they wished to trade with other countries. They have, therefore, always been a sea-going nation, and it is quite natural that clever shipbuilders should be found in those parts of the British Isles that are suited to this industry.

But in the days when ships were of wood and carried sails, France and America were both more important than Britain for the building of ships. Even when Watt invented the steam-engine and it became possible to drive a ship by steam, the first steam-boat was built, not in England, but in America. On the other hand, the first steamship that went out into the open sea was built at Glasgow, in Scotland. It crossed regularly between Glasgow and Belfast, and, later, between Dover and Calais.

It was not long, however, before Britain took the lead as the greatest shipbuilding country in the world, and, at the present time, about one-third of all the ships afloat have been built in British shipyards. In the British Isles there are three very important shipbuilding areas, one in England, one in Scotland, and one in Ireland. The *Mauretania* was built on the Tyne, the *Titanic* at Belfast, and the *Queen Mary* on the Clyde. Of these areas Clydeside is the most important.

Before a ship can be built much hard thinking has to be done, so that when it is finished it will be able to withstand storms and, in other ways, be safe at sea.

Before the shape is actually fixed a model of it is made of wax. This is floated in water, and measurements are taken



[Courtesy, Vickers-Armstrongs, Ltd.

Drawing the plans of a ship.

which help the man who plans the ship to say how strong the engines must be to carry her along at a given speed. When both the size and the shape of the vessel have been fixed, other men draw plans of all the different parts, so that those who make them know exactly what is wanted.

Alongside the building yard is a very large room, about one hundred yards long, with a floor like a blackboard. On this floor full-sized plans are drawn in chalk.

The ship is built on land on a strip of concrete that slopes gently up the river bank. This concrete strip is the slipway. Along each side of the slipway is a row of ten or more steel

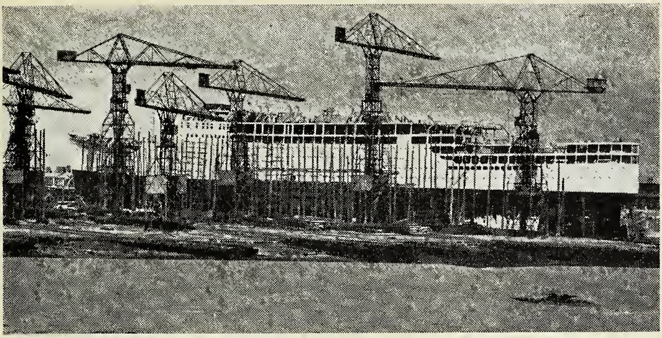
framework towers, fitted with cranes for lifting heavy parts into their proper positions.

The keel of the ship is built first. This is made, not right on the ground, but on piles of stout blocks of timber. A line of steel girders is laid on these blocks, to form the backbone of the ship. To it the ribs are fixed, one about every yard, along its whole length. As the bottom of a ship is nearly flat, the ribs are almost level for about twenty feet, after which they curve upwards to form the sides. The ribs are held in position by means of steel bars, which run from the stern to the bows, and keep the whole framework strong and rigid.

The girders and bars are made at a steelworks. When they reach the shipyard they are straight. Before they can be fitted into the ship they have to be heated and bent into the right shapes. These shapes are drawn in chalk on a steel floor, in which there are hundreds of small holes. Steel pegs are driven into the holes along the chalk lines to act as guides. The bars are heated in a furnace. When they are soft enough they are taken from the furnace, placed on the steel floor, and bent round the pegs.

When the framework of the ship is finished, it is covered with steel plates, each about thirty feet long and five feet wide.

When a ship is being built the noise is deafening. This is because all the girders, bars, and plates have to be fastened together by means of rivets, which are like very thick nails. Before the plates are fixed to the framework they are carried by a crane to a punching machine, which stamps holes through them. This machine punches holes through a piece of steel an inch thick as easily as a ticket collector punches a hole through a railway ticket. From the punching machine the plates are swung over to the framework, where men fix them in position with a few nuts and bolts. Then they have to be securely



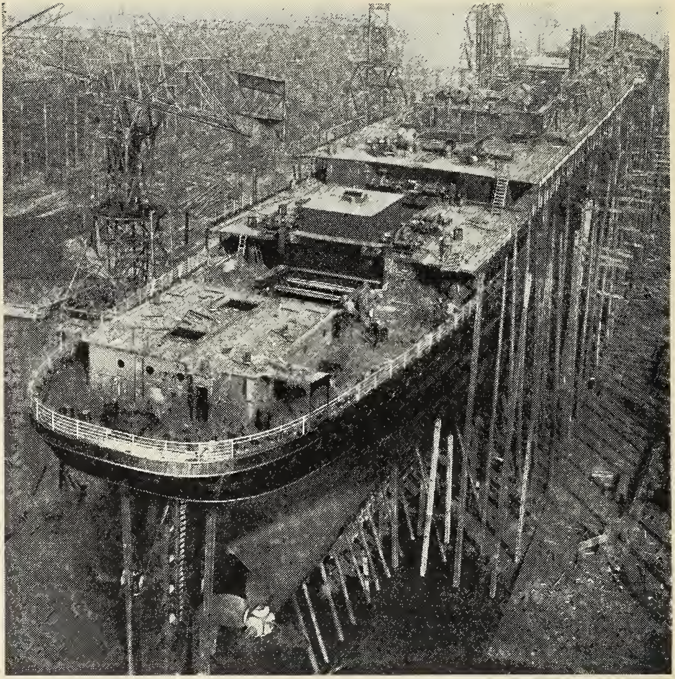
[Courtesy, Vickers-Armstrongs, Ltd.

A shipbuilding yard.

fastened with rivets. In a big liner about three millions of these are used.

A riveting gang consists of three men and a boy. Two men work on one side of the plate, one man and the boy on the other: the boy has to keep the rivets white hot in a small furnace and pass them to the riveters as quickly as they are needed. He takes one from the furnace with a pair of pincers, and pushes it through the holes in the plate and the frame. The man on his side forces it in with a heavy hammer while the other two men strike the part which sticks out and flatten it into a head. The striking makes the part of the rivet in the hole expand and bite into the steel, so that it holds tightly even after the burred end is filed away. For months the noisy work goes on, and when it is finished about a thousand tons of rivets have been used.

Every plate in a steel ship, like every board in a wooden ship, overlaps those next to it, and the joins must be made tight and closely stopped up, or water would leak into the vessel. In the days of wooden ships the joints were closed by forcing tow



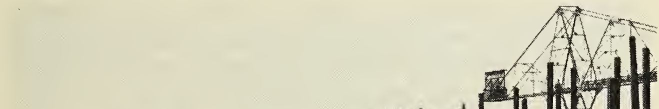
[Courtesy, Vickers-Armstrongs, Ltd.

A ship in a shipyard ready to be launched.

between the boards. In a steel ship there are two or three rows of rivets, each two or three inches apart, along each joint, and the edge of the upper plate is also driven down by means of a hard steel chisel till it bites into the surface of the plate beneath.

When the steel shell of the ship is finished it is painted to prevent the metal from rusting, and then comes the great day

for its launching. The piles of wood underneath the keel are replaced by lines of solid blocks of timber, all heavily smeared with soft soap to make them slippery. A lady of importance christens the vessel by breaking a bottle of wine over the bows, and, with the proud master builders on board, the vessel slowly glides into the water. It is, however, far from finished, and work will be continued for several months. The engines have to be lowered and fitted into the engine room, and the masts, funnels, and other steel parts have to be erected. Scores of carpenters are kept busy fixing the decks and the partitions to the cabins and saloons; glaziers fit in the porthole windows; electricians lay on the light and the power for electric fans; painters make the interior look spick-and-span, while upholsterers make it as comfortable as any hotel on land.



[Courtesy, Vickers-Armstrongs, Ltd

Launching a liner

The banks of the Clyde are the greatest shipbuilding area in the whole world. This is due to many reasons. The genius of the old engineers and the skill of the workmen gave the industry a good start even in the days of the wooden steamship. When iron, and then steel, began to be used, the Clyde became even more important, for there was a good supply of iron in the Lanarkshire coalfield and plenty of coal for use in the steelworks and to supply power for the machines. The timber is not grown locally, but this can be imported from Sweden to the Firth of Forth, and then sent by barge through the Forth and Clyde Canal. Some iron is also imported from Sweden along this route.

The sheltered estuary was suitable for the launching of the small ships of early days, but as vessels grew larger, the Clyde was found not to be deep enough and the estuary had to be dredged. Now the biggest ships in the world can be launched from its banks. We can say that if the Clyde first helped to make the shipbuilding industry important, it was shipbuilding that, later, made the Clyde into a first-rate waterway.

EXERCISES

1. In the British Isles large ships are built in four important areas: (*a*) the banks of the river Clyde; (*b*) along the estuaries of the three rivers of Durham; (*c*) at the mouth of the river Lagan, in Ireland, and (*d*) in Furness.

Mark these areas on a map, and write down the name of one or more towns in each area.

2. Draw a map of (1) the estuary of the Clyde, (2) of the County of Durham. Insert the high land, name the rivers, and insert and name the principal towns.

3. What are the actual advantages of the banks of the river Clyde for shipbuilding?

4. Make a list of as many crafts as you can that help in the building of a ship.

5. Imagine that an ancient mariner of the days of Columbus were to visit a modern liner. What difference would he note between the ships of his day and those of ours?

CHAPTER 12

THE ENGLISH TEXTILE INDUSTRY

IF we take a piece of cloth and pull it to pieces, we shall find that it is made of threads. If we take one of these threads and pull it to pieces, we shall find that it is made up of much smaller pieces twisted round each other. Making the threads is called *spinning*, and spinning was known to the early hunting and fishing peoples. They had to learn to spin before they could make nets for catching fish or ropes to help them to catch wild beasts. Spinning must be almost as old as the Old Stone Age.

The Old Stone Age people had not, however, learned to *weave* cloth. If we look at our bit of cloth again, we shall see that it consists of two sets of threads, plaited or woven together like the separate pieces that make up a wicker basket. The people who first made wicker baskets probably went on to make mats and rugs in the same way, using reeds, rushes, grasses, and narrow leaves. At any rate, the New Stone Age people knew how to weave, and the interesting thing is that, though we now make miles of cloth in huge factories and use powerful and very wonderful machines, the method of making the cloth is practically the same. Science has simply shown us how to do the same kind of work as our distant ancestors more quickly and cheaply.

If we had time, we could go to different parts of the world and see people in these days making string after the manner of the Old Stone Age people or weaving cloth in ways almost as simple as those used by the New Stone Age people. As we have not time, we will stay in Britain and see what has happened there in the manufacture of textiles.

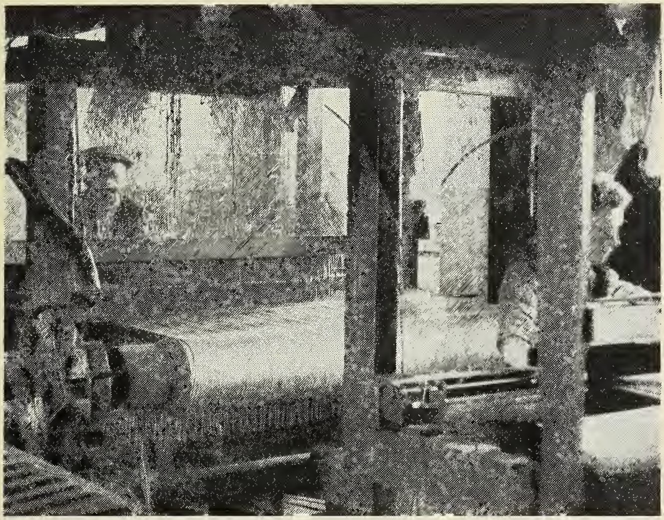
A textile is a material that has been woven and includes all such things as woollen blankets, coco-nut matting, cotton sheets, jute sacks, silk neckties, and linen handkerchiefs. We cannot study all these things. We must be content to speak of only one or two of the most important. The oldest British textile industry is the making of woollen cloth, so we may begin with that.

From very early times England has been famous for her sheep, which are kept partly for their mutton and partly for their wool. At one time wool was our most important export, and even in Roman times woollen cloth was made in England. We can pass over the story until the reign of Edward III. This king allowed wool workers from some parts of the continent of Europe to come over to England to carry on their work in this country.

Many of the weavers settled in Norwich and other towns in the east of England. There were plenty of sheep on the dry chalk hills and plenty of water in the streams. Water was needed almost as much as wool, for half the weight of the fleece of a sheep is grease. This grease has to be washed out before the wool can be spun into yarn. The woven cloth, also, has to be washed to make it thick.

The cloth was, in early days, made in the cottages of the workers. The spinning of the wool was done by women, and because it was usually the girls who were not married who did the spinning they were called *spinsters*. Three spinsters were needed to supply one weaver with the yarn he required.

Then there came a great change. Some rich men built small factories and paid the spinners and the weavers to work for them in these buildings. The work was still done by hand, but the workers, instead of being their own masters and selling their own cloth, sold their labour, and received wages for the work they did.



[Keystone.

Linen weavers at work in a cottage.

Even in those days the dales of Yorkshire were found to be more suitable than Norwich or Lincoln for this industry. The dry, eastern side of the Pennines, covered with short, fine grass, is one of the best sheep-rearing regions in England. The water in the Aire and Calder was found to be pure and soft and suited for washing the wool. The fast-flowing streams from the Pennines could be made to turn the water-wheels which worked mallets up and down in the washing tanks.

As years passed the farmers were able to produce better fleeces; the weavers became more skilful in their art, and Parliament helped the industry, too, by ordering all people to wear only garments made of wool. By these means the

making of woollen cloth became the most important occupation, next to agriculture, in the country. Soon, however, a great rival textile made its appearance.

Northern Ireland, as we shall see in Chapter 14, is a very important area for manufacturing linen, and a few of the linen workers crossed over to Manchester, and there began a small linen industry. In the sixteenth century another textile fibre, cotton, grown in the eastern Mediterranean lands, was brought over to London. This was sent to Manchester, partly because the Manchester weavers could deal with fine linen yarns. At first the cloth that was made was looked upon as a poor imitation of wool, and the fibre was called cotton-wool.

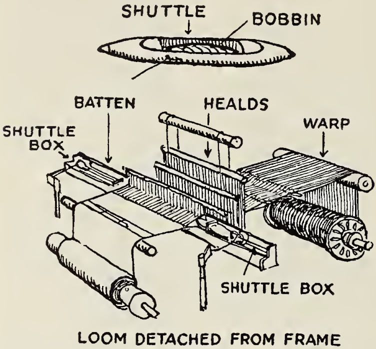
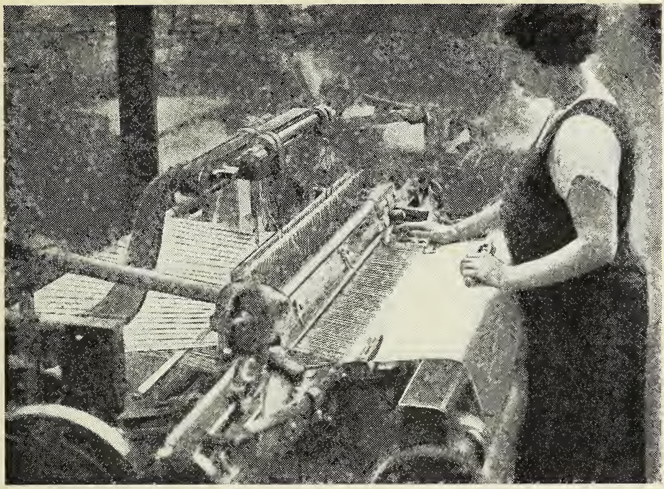


Diagram showing how a loom weaves cloth.

Though the spinners and weavers were clever with their fingers, they did not really make a great deal of cloth because they worked so slowly. Think of what it meant to weave a piece of cloth by hand !

A large number of threads had to be laid side by side to form a *warp*. Then the threads had to be lifted so that those numbered 1, 3, 5, 7, etc., were raised up above the others. Then a shuttle full of yarn was shot between the two parts of the warp, thus putting in a cross thread, the *weft*. The even-numbered threads were next raised, the odd ones lowered, and the shuttle shot back again. After each movement of the shuttle



[Keystone.

Placing in the loom the shuttle, which weaves the weft into the warp, so making cloth.

the new thread of the weft was pressed tight against its neighbours.

The shuttle had to be thrown by hand, and, in the case of a wide piece of cloth, one man had to stand on each side in order that the shuttle might be thrown to and fro.

Progress began only when machines were invented for making all these movements. The first great invention was one for shooting the shuttle through the warp. This made it possible to weave twice as fast as before, and the spinners could not make thread fast enough to supply the weavers with all the yarn they needed. A weaver, however, invented another machine by which a dozen threads could be spun at the same time simply by turning a handle.

Other machines were afterwards invented which spun more and finer yarn, or lifted the threads of the warp and threw the shuttle across them more and more quickly. The workers did not like these machines. They drove away from his home-town the man who invented the "flying shuttle," and they broke into the house of the one who invented the new weaving loom and smashed his machines. They were afraid that the machines would work so well that soon there would be little work for men and women to do with their hands.

Because most of these machines were driven by water power the mills in which they were used were built along the Lancashire and Yorkshire dales where there were swiftly flowing streams from the Pennines. Cotton and woollen workers who had no such streams could have no such machines. The woollen trade at Lincoln and Norwich died out, but grew quickly in Yorkshire as the cotton trade did in Lancashire.

By the time the new loom for weaving had been invented, Watt had also invented his steam engine, and it was not long before the machines for both spinning and weaving were being driven by steam power. Fortunately, both the cotton and woollen industries had already found a home on the coal-fields, where steam power could be produced cheaply.

EXERCISES

1. Under the headings "animal products," "vegetable products," and "minerals," write down the names of all the materials you can think of that are used for clothing. Put a star against those that are textiles.

2. Make a list of the common things that are woven. Draw a diagram to show that you understand how threads are woven together.

3. With the aid of other books write an account of the life and work of one of the following: John Kay, Edmund Cartwright, Richard Compton, James Hargreaves, or Richard Arkwright.

4. The following are some of the chief textile regions of the world: Massachusetts, Georgia and Alabama, Flanders, Saxony, Ulster, Japan, China, and the areas around Bombay, Lille, Rouen. Mark these on a map of the world.

CHAPTER 13

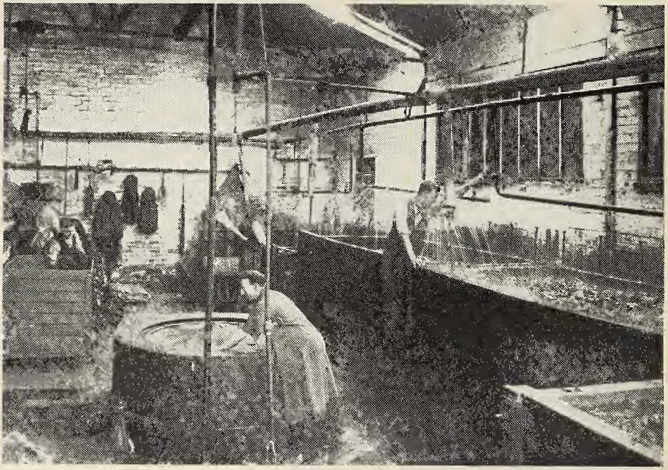
WOOL AND COTTON WORKERS

IN the last chapter we have pointed out the way in which the woollen and cotton industries grew up in England. There is, however, something more to be said about these industries.

In the first place we have to note that, though there are twenty-four million sheep in Great Britain, they do not produce enough wool to keep the woollen factories busy. About a third of a million more tons of wool are imported from abroad, chiefly from Australia, New Zealand, and Argentina. Most of the imported wool, packed in huge bales, arrives at the port of London to be sent to the West Riding of Yorkshire, where, at Leeds, Bradford, Huddersfield, Halifax, Wakefield, Dewsbury, and a number of smaller towns, the raw wool is made into cloth.

The workpeople in these different towns do not all make the same kinds of woollen goods. Some of the towns are well known for their carpets, others for good worsteds, others for excellent woollen cloth, and others for a much cheaper material. We cannot learn how all these things are made, so we will follow the work done at Dewsbury, where cheap cloth is made.

On the ground-floor in a large room we should see the huge bales being ripped open and their contents spread over the floor. The different kinds of wool obtained from different countries are here roughly mixed together by men with rakes. As most of this wool is dirty and some of it is greasy, it must be washed. It is passed into a long tank full of warm, soapy water, and is paddled along by forks, which are worked by machinery. At the far end the dirty water is squeezed out and the wool goes into two more tanks of cleaner water, after which it is dried in a current of hot air.



[Commercial Graphic Co.

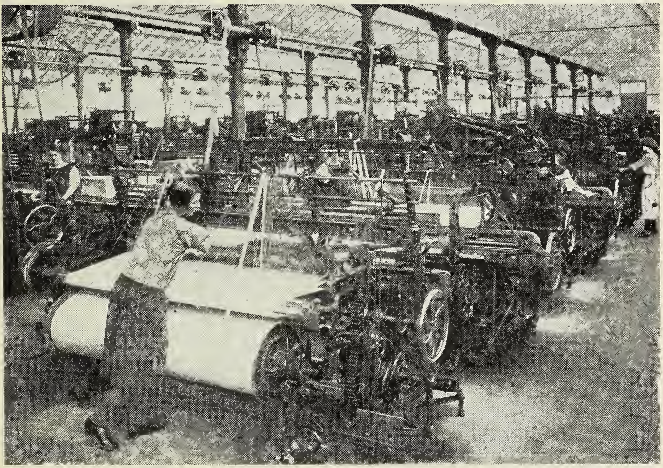
Washing and disinfecting rags, which will be torn up and used to make new cloth.

Because new wool is costly the makers of cheap cloth at Dewsbury often use a great deal of *shoddy*, that is, old cloth and rags. Bits of cloth from tailors' shops and old garments collected by rag and bone merchants are sent to Dewsbury, where they are torn to shreds in a rag-grinding machine. The old stuff and some new wool are mixed together and spun into yarn.

The yarn next goes to the weaving room, which is full of looms and very noisy. When the cloth comes off the loom it looks something like sacking and is very coarse. To make it woolly it is well washed and passed through a heavy mangle, which mats the hairs more closely together. It is then dried and passed between rollers covered with teasels, which brush up the loose fibres and make the cloth fluffy. The fibres,

however, are not all of the same length, and the longer ones have to be cut off by a machine which contains blades that go round like those of a lawn-mower. Finally, the cloth is pressed, steamed, folded, rolled, and sent to the tailor. The tailor makes it into suits. When these suits are worn out, they may find their way back to the mills of Dewsbury, and the wool in them be used over again.

If we go up the valley of the river Aire, we leave the Yorkshire coalfield behind us. We pass along a low gap, the Aire Gap, through the Pennine moorlands, into the valley of the river Ribble. We are now in a cotton-spinning and weaving area, which obtains its power from the South Lancashire coalfield. Here the chief towns are Manchester, Blackburn, Bolton, Bury, Burnley, Oldham, Rochdale, and Preston.



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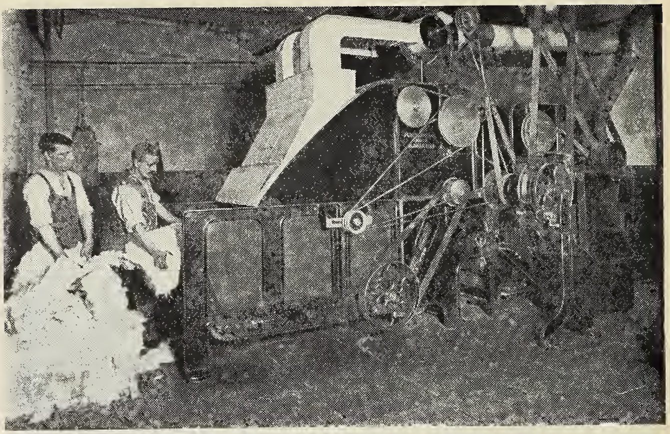
The weaving shed of a woollen mill.



Opening bales of cotton at the mill.

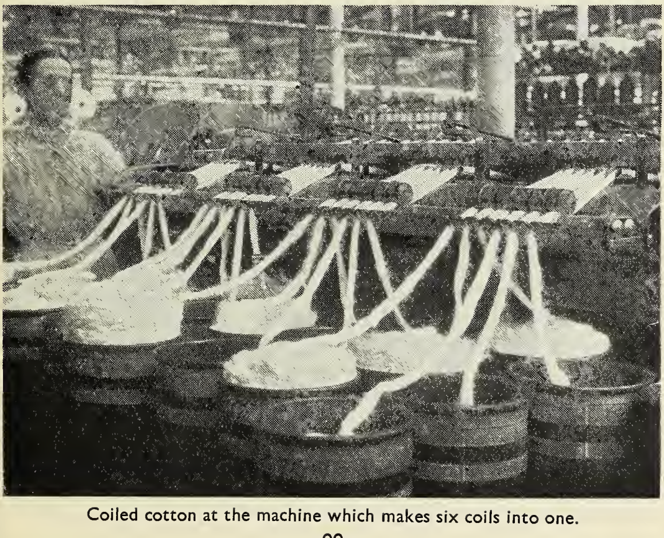
Cotton, chiefly from the United States of America, arrives by ocean steamers, and is unloaded at Liverpool or forwarded to Manchester by means of the Manchester Ship Canal. The bales are afterwards often sent direct by smaller canals to the tall spinning mills that are built upon their banks. The bales, each of which contains about four hundredweight of raw cotton packed tightly together, are bound round with iron hoops.

At the spinning mill the bales are opened, the matted cotton is spread out on a platform, and mixed with rakes. Raw cotton, like raw wool, contains a good deal of grit and dirt, but instead of being washed, it is cleaned as it passes on its way. One machine beats out the dirt and loosens the tangled masses of cotton fibres. Another still further separates it by passing it over many rollers with wire teeth, and delivers it at the other end in the form of soft, spongy rolls. These go into a third

machine, which still further separates the fibres, and makes them into loose cords, which it coils into tall tin cans.

In this part of the mill great care has to be taken because of the danger of fire. If the wire teeth of the rollers should strike a piece of grit, they might make a spark and set the fluffy cotton fibre alight. For this reason several fire extinguishers are placed in every room, and steel staircases are fixed to the outside walls of the tall buildings to give the workers an easy way to escape if fire breaks out.

The cans of coiled cotton are taken to a machine, where six coils are pulled out and made into one no thicker than one of the six that went in. The fibres are, at the same time, straightened and laid side by side. More twisting of the fibres is done by another machine, and at last the cotton yarn



Coiled cotton at the machine which makes six coils into one.

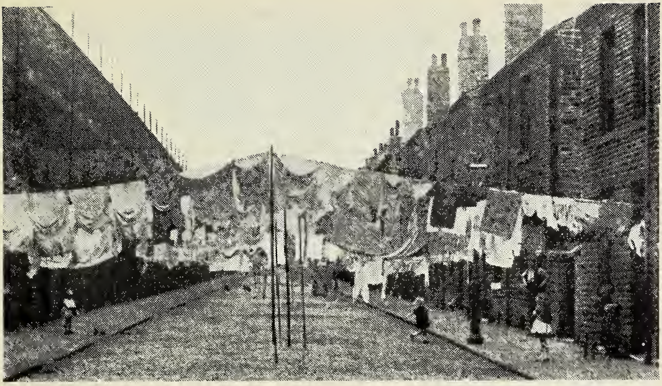
is ready for the weaver. The work of cotton spinning is usually done by men.

The work of weaving is generally done by women. It is carried out in long sheds with a good top light, so that the women can clearly see what they are doing. One woman looks after four looms, and is kept busy placing fresh cotton in the shuttle and mending any threads that snap.

After the cloth has been woven it is generally bleached to make it perfectly white. Some of it, however, is dyed, while some goes to the printer to have a pattern stamped on it. The finished textile is then sent to shops, where it is sold and made into clothing, and after this is worn out it goes to the rag and bone man. The old cotton garments, however, do not go back to the cotton mills: they go to paper mills to be used in the manufacture of paper.

We have seen that, as men made progress in the way of living more easily, they left off trying to do everything for themselves. There was division of labour. In the cotton industry there is a great deal of division of labour, not only in the mills, but between the mills, for some firms only spin yarn and others only weave cloth. There is also a great deal of division of labour between the towns. Nearly all the mills in Oldham, Bolton, and Bury spin yarn; those in Blackburn and Preston weave cloth. That is, perhaps, not a very wise division of labour, for the yarn has often to be sent from one town where it has been spun to another where it is woven, and moving the cotton about in this way costs money and makes the cloth dearer.

The factory towns of northern England, where woollen and cotton goods are chiefly made, are all somewhat alike: dreary, drab, and far from pleasing to the eye. Most of the older mills are plain, ugly buildings, and their chimneys are always sending out smoke to darken the air and dirty the walls.



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Washing day in a Yorkshire woollen town.

Many of the streets are straight and narrow, and so close together that the houses in one street often have their backs against those in the next. Thus every house touches others on three sides, and there are no gardens. Fortunately back-to-back houses like these are no longer built.

Women in these towns have hard work to keep their houses clean, but the insides of the houses are often as neat and tidy as the streets are ugly and untidy. The workers are fond of good meals, and some of their dishes, like Yorkshire pudding and Lancashire " hot pot," have found their way into many parts of the world. They are fond of music, and both sing and play with much taste. They are fond of games, and, on Saturdays, thousands of the mill workers go to see their favourite teams play cricket and football. Some of the strongest football teams and some of the best cricket teams come from Yorkshire and Lancashire.

They are also fond of a holiday, and all the mills close for one

week during the summer. All those in the same town stop work for the same week, so that the people in that town can take their holiday at the same time. They go, in thousands, to one or other of the seaside resorts upon the coasts that lie so near the coalfields. It costs less to travel to a place near at hand, and there is more money left for amusement. Lancashire folk go to Blackpool, the Isle of Man, and North Wales; Yorkshire folk go to Scarborough, Bridlington, and Whitby.

EXERCISES

1. Describe the route taken by a bale of wool from Australia to London and thence by train to Leeds.

2. Draw a large map of Yorkshire. Shade the uplands and insert and name the chief rivers. Mark the following towns where woollen goods are made: Leeds, Bradford, Huddersfield, Halifax, Wakefield, Dewsbury, and Batley.

3. Make a list of the chief advantages of the West Riding of Yorkshire for the manufacture of woollen goods.

4. What are the chief advantages of Lancashire for the making of cotton goods?

5. Cotton and woollen goods are made in other parts of the British Isles. Learn the following table and mark the places on a map of the British Isles: Witney, Kidderminster, and Kilmarnock (carpets); Paisley (sewing thread); Nottingham and Leicester (hosiery); Stroud, Frome, Bradford-on-Avon, Hawick, Galashiels, and the Hebrides (woollens); Glasgow (cotton).

6. Large quantities of cotton goods are sent abroad to the tropics, while most of the woollens remain in Europe. Why is this?

7. Make a list of the professional football clubs that have their grounds in the textile towns of northern England. Explain why there are more of these clubs in Lancashire and Yorkshire than in Norfolk or Cornwall.

CHAPTER 14

THE LINEN WORKERS OF ULSTER

ONE of the oldest textiles is linen. It was manufactured by the ancient Egyptians, who were clever weavers of a very fine material. They wrapped their mummies in it. It is probable that the Phœnician merchants carried Egyptian linen with them on their voyages, and showed the people of the lands they visited how it was made.

Linen, like cotton, is made from a fibre taken from a plant. In the case of cotton, as we have seen, the fibre is found in a fluff round the seeds; in the case of linen the fibre is contained in the stem of a plant called flax. Flax gives, not only fibre for linen, but also seeds, which are used in making linseed oil. This oil is used in large quantities for making paint. Unfortunately, if the plant is grown for the fibre, the seeds are wasted, for the flax for linen has to be harvested before the seeds are ripe.

Cotton can be grown only in places that have a hot summer, but flax does well in a much cooler climate. It is widely grown for its fibres in Russia, Belgium, and northern France. At one time it was a common crop in many parts of Ireland, but as flax can be bought more cheaply in Europe, the quantity cultivated in Ireland has become much smaller. It is, however, still an important crop in the north-east, that is, in Ulster.

Flax is not an easy crop to grow. Its roots go down a long way into the ground, so that the land has to be very deeply ploughed. It also needs very careful weeding by hand.

About July the flax fields, with their small blue flowers and thin green stems, each about two or three feet high, form a very beautiful picture. A week or so later the flowers fade, the

stems begin to turn yellow, and the farmer knows that it is time to reap the harvest.

A bunch of flax.

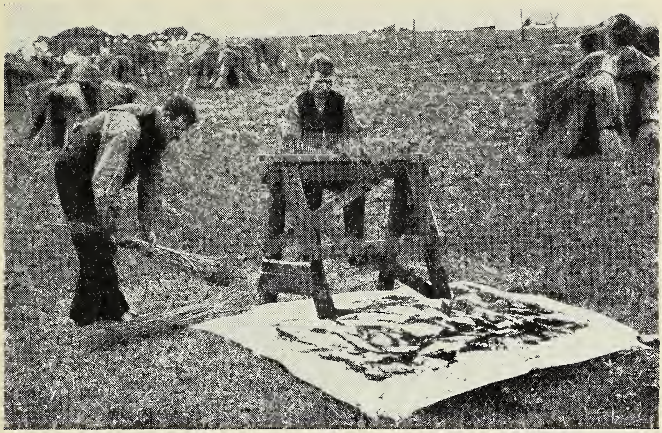
Flax is not cut: it is pulled up by the roots. A number of men and women, boys and girls form a long line across a field, and, with much aching of the back, move slowly forward, lifting the crop, a handful of stems at a time. The plants are struck against the boot to knock off the dirt, after which they are laid in long rows, side by side, on the ground, to dry.

The flax plant has thin branches and a number of seeds as well as a stem, and the stem contains woody straw as well as fibres. The linen manufacturer wants only the fibres and nothing else.

The first thing to be done is to get rid of the seeds and branches. The plants are pulled through a kind of comb. This removes the leaves, the thin branches, and the unripe seeds. The seeds fall on a sheet, and are kept for feeding cattle. The stems are tied into bundles, formed into stooks, and left to become completely dry.

The next thing to be done is to get rid of the woody straw that surrounds the fibres in the stem.

A number of shallow ponds are



[W. A. Green, Antrim.

Removing the seeds from the flax.

dug, usually alongside streams. In these the farmers place the stems. For a day or two they paddle about in the water with their trousers rolled right up above their knees, sinking bundles of flax to the bottom. They then cover the flax with layers of straw or rushes and weigh them down with heavy stones.

This soaking in water is to rot the woody part of the stem, but it is not carried out in the same way in all flax-growing countries. In Russia the crop is simply left for several weeks in the dewy fields. This is easier than paddling about in a pond, but the results are not so good. In Belgium, where the best flax is produced, the stems are put in huge wooden crates and sunk by stones in the river Lys.

After about twelve days in water the flax is removed, the water is drained away, and the stems are spread out in the

[W. A. Green, Antrim.

Taking the flax out of the water where it has been soaking.

meadows for another twelve days to dry in the sun and the wind.

When they are dry and brittle they are gathered up and taken to a mill, where a machine breaks up the rotted wooden part and scrapes the pieces away from the linen fibres. These fibres contain a certain amount of gum, and that, also, must be removed. In the mills where the fibres are spun into yarn, the yarn, at one stage, is passed through a tank of hot water. The air is therefore always warm and moist, the floors are always wet, and the spinners, who are mostly women, generally work with bare feet.

The spun yarn is taken to the weaving shed and woven on a loom in much the same way as cotton and wool are woven.

The colour both of the fibre and of the linen, when it comes from the loom, is that of flaxen hair. Some linen is sold in this yellowish-brown state, but most of it is bleached, that is, made white.

It takes a long time to obtain a pure white colour. The long strips of linen are soaked in weak chemicals and washed time after time. Between each washing they are laid on grassy lawns, where sun and moist air do their share of the bleaching. Near to most of the big linen factories of Ulster, one can generally see miles of dazzling white linen lying on the ground.

When thoroughly white the material is starched, dressed, and cut up for handkerchiefs, shirts, collars, tablecloths, and other useful articles. Most of these go to the sewing room, where the edges are hemmed round by machine, but some of the finest material is taken away by farmers' wives to be delicately embroidered in their own cottages. When finished, the articles are again dressed and ironed, tied into bundles with fancy coloured ribbon, and placed in artistic boxes ready for the drapers' shops in many parts of the world.

[Courtesy, Old Bleach Linen Co.

Linen laid out on the grass to bleach.

We know that machines need power, and that this power, in Britain, is steam power produced by burning coal. Ulster, however, has very little coal, and has to import it, chiefly from the Cumberland coalfield in northern England or from the Ayrshire coalfield in Scotland. Each of these coalfields is not far away, and each is on the coast, so that there is little or no expensive carriage by rail.

In this book we have chosen to speak of the woollen industry of Yorkshire, the cotton industry of Lancashire, and the linen industry of Ireland, because these are the most important regions where these industries are carried on. But there are similar industries in other parts of Britain. There are, in Scotland, for instance, woollen mills at Hawick and Galashiels, factories where carpets are made from wool at Kilmarnock, linen mills at Dunfermline and Dundee, and cotton mills at Glasgow and Paisley. All these places are on or near the coalfields of Scotland. There are no factory towns in the Highlands.

EXERCISES

1. On a map of Ireland indicate the flax-growing region according to the following table :

Thousands of Acres of Land sown with Flax

Down	24	Armagh	13
Antrim	21	Donegal	11
Londonderry	16	Monaghan	6
Tyrone	15	Cavan	2

2. Linen goods are also made in eastern Scotland. Mark the following linen towns on a map: Montrose, Arbroath, Dundee, Perth, Kirkcaldy, and Dunfermline.

3. What are the advantages of Ulster for the making of linen goods?

4. Draw a large map of northern Ireland. Insert and name the rivers Bann, Lagan, Foyle, and Blackwater; Lough Neagh, the Mountains of Antrim, Mourne Mountains, and the Sperrin Mountains.

Insert and name the following towns connected with the linen industry—Belfast, Londonderry, Armagh, Lisburn, Newry, Portadown, and Ballymena.

CHAPTER 15

SILK

IN the last three chapters we have read about three different textiles—cotton and linen and wool. The raw material for cotton and linen is produced by a plant; the raw material for wool is produced by an animal. In this chapter we are to read about another textile—silk—the raw material for which is produced by another animal, called the silkworm. It is not really a worm: it is a caterpillar.

The female moth lays about five hundred eggs and then dies, after living for but a few days. These eggs are placed on trays covered with clean paper in a room which is kept at a steady warmth. When the eggs hatch out, tiny little grubs are seen. The grubs are fed on mulberry leaves, and grow rapidly until they are about two inches long. During these few weeks they shed their skins five times. They then crawl away amongst some straw or twigs and spin their cocoons. Each of these cocoons contains about a quarter of a mile of the finest silk thread, no thicker than the threads in a spider's web.

When the cocoon is finished the caterpillar turns into a chrysalis. This chrysalis would, if left alone, turn into another moth and burst out of the silky cocoon. But it is not left alone. The silk rearer kills it by putting the cocoon over boiling water. The steam not only kills the chrysalis, but dries it up so that it falls to powder, and can easily be shaken out through the silky covering.

The silk fibre in the cocoon is very very fine, and it must be reeled off very carefully. Eight cocoons are floated in a trough of warm water. The warm water softens a kind of gum that sticks the fibres together and allows the silk to be unwound. The ends are loosened with a little brush and drawn

through four small rings; two fibres pass through one ring and become united into one. This gives four threads from eight cocoons. The four threads are then twisted, in pairs, to form two, and these are again twisted together to make one thread, which is fastened to a wheel. As the wheel is turned slowly round the silk is unwound from the cocoons. When about three-quarters of a mile have been wound on to the wheel, the silk is removed and made into a hank, or skein. It is in this form that it is sent to the factories to be made into silk cloth.

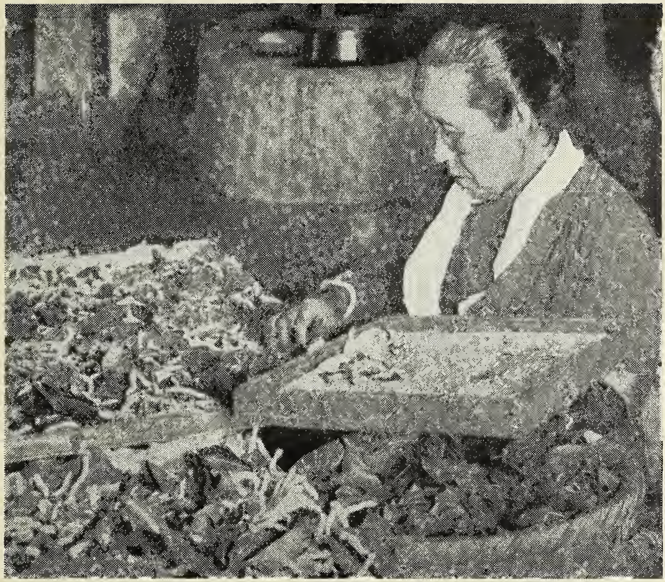
Silk can be produced in many countries that have a climate suitable for the growing of mulberry trees. The production of silk, however, needs so much care and attention that it can be carried on profitably only in countries where wages are low and the people live cheaply. The chief silk-producing countries are China, Japan, Italy, Turkey, and southern France.

Most of the raw silk remains to be woven in the country where it is produced, and China, Japan, Italy, and France are all important for manufacturing silk goods. Some of the raw silk, however, goes to Britain, and is sent to Coventry, Macclesfield, and Derby.

As we have seen, much has to be done to wool, cotton, and flax before they can be made into yarn for the weaver, and silk too, although it is in one long thread, has also to be specially treated before it can go to the loom.

The hanks of silk, after being sorted according to their quality, are opened up and placed round large wheels in a winding machine which winds the threads on to bobbins. Although each of these threads consists of eight silk fibres twisted together into one, that thread is still too fine and weak to be used on a loom. By means of a spinning frame, therefore, two of the threads are further twisted together.

The silk yarn has to be washed, not, as in the case of wool, to remove dirt, but to get rid of any gum that may still be sticking



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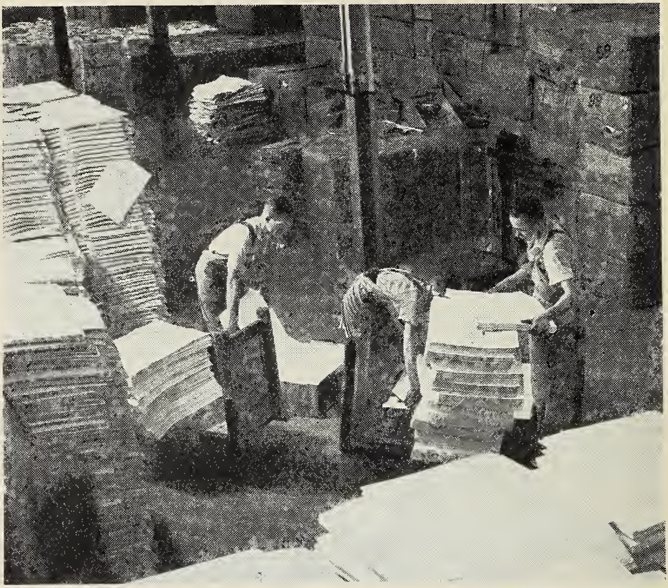
Silkworms being placed on trays of fresh mulberry leaves to feed.

to the fibres. After the washing is over the yarn is dried, once more wound on to bobbins, and sent to the weaving room.

Silkworms, as we have said, need a great deal of careful attention, and it takes thousands of silkworms to produce enough silk for one dress. Silk is, therefore, very expensive, and some men of science began to wonder if they could not make silk thread without keeping any silkworms. At first sight this seems as silly as trying to grow wool without rearing any sheep, but a Frenchman actually found out how to do it.

He watched the silkworms to see what they did. He



[Courtesy, Messrs. Courtaulds.

Sheets of wood pulp, from which rayon is made.

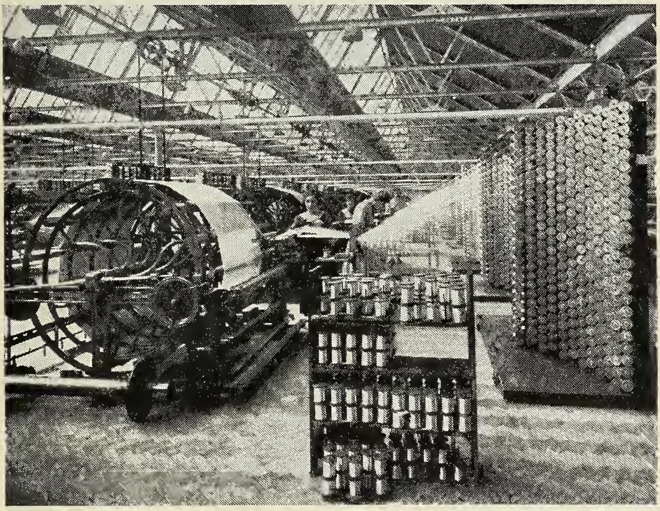
noticed that when the silkworm spun a cocoon it squeezed a sticky liquid out of its body through two tiny holes near its mouth and that these two fine threads stuck together and hardened in the air. He thought to himself that if he could find the right liquid and squeeze it through two tiny holes, perhaps he could make a thread that would, at any rate, look like silk.

We know that he succeeded because to-day, at Coventry, and Bradford, and other towns in England, and at other towns too, in other parts of the world, there are great factories making artificial silk, or *rayon*. These factories and their machines

are not fed on mulberry leaves, but on wood pulp made from spruce and other cone-bearing trees from the forests of Scandinavia, Canada, and Finland.

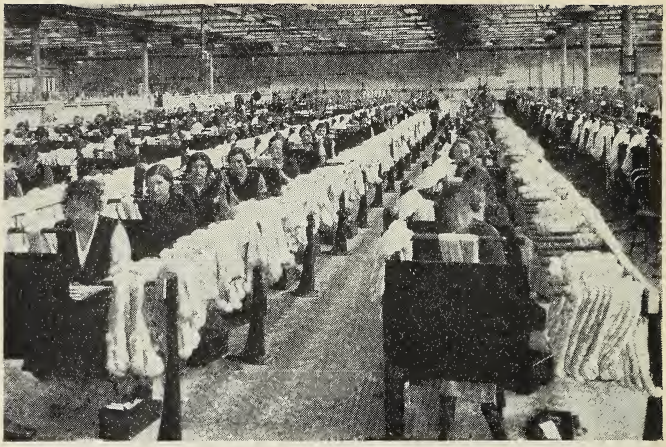
Before the pulp can be squeezed through little holes, it is softened, torn into shreds, and heated with chemicals : it then looks like yellowish-brown dough. This substance is dissolved in water to form a thick and sticky liquid. It is filtered to take out any bits of solid matter that may be present, and flows into a large tank that we may look upon as the inside of the body of this machine silkworm.

Now for the little holes. From the tank several tubes dip down into a trough. At the end of each tube is a cap with



[Courtesy, Messrs. Courtaulds.

Making the Warp : The threads of yarn are drawn from the bobbins through a fine comb and then rolled on a revolving circular frame.



[Courtesy, Messrs. Courtaulds.

Hanks of the finished rayon being inspected and graded.

not two, but twenty tiny holes bored in it. When the machine is at work the sticky liquid is forced through the tubes and oozes out through the holes into the trough, where it hardens to form twenty fine threads from each tube. In one factory alone, one hundred and forty miles of this kind of thread are made every second of the day.

From the trough the twenty threads are withdrawn over a roller and coiled in a round box. The box spins round and round and twists the threads all together to make one piece of yarn. The yarn is washed and bleached, and then sent either to the weaver, who makes it into silky-looking cloth for dresses, ribbons, and neckties, or to another factory to be knitted into stockings.

We have, in these books, read of a number of inventions that men have made in order that things may be produced more

quickly and cheaply, and perhaps of better quality. But none of them is really as clever as this one, which makes a sticky liquid out of a solid lump of wood and turns that liquid back again into a piece of delicate thread. It works as well as a living silkworm that eats a mulberry leaf, digests it in its inside, turns it into a liquid, and squeezes it out of the holes by its mouth into a fibre of silk. The silkworm, however, in one way beats the machine: real silk is much warmer than artificial silk.

EXERCISES

1. The following are the principal silk-producing countries of the world—China, Japan, Italy, Korea, France, Indo-China, Turkey, and Southern Russia. Mark these places on a map of the world. Explain why raw silk is not produced in England.

2. Why is artificial silk cheaper than real silk, and why is it manufactured in England to a greater extent?

3. Of what textile materials are the following made: (1) tweed suits, (2) sheets, (3) blankets, (4) handkerchiefs, (5) neckties, (6) ladies' stockings, (7) carpets, (8) umbrellas, (9) coal sacks?

4. Find out the kind of textile manufactured at each of the following towns: Bradford, Coventry, Galashiels, Bolton, Belfast, Lyons (France), Dundee, Kidderminster, Milan (Italy), Rouen (France).

CHAPTER 16

HOW MAN USES THE FOREST

Timber

EVEN in the Old Stone Age man had found many uses for wood, and bits of wood charcoal that he left behind seem to show that he used it for heating. In the New Stone Age, with better tools, he used it more and more. In early days it provided heat, tools, and, later on, charcoal and pitch, and ashes for fertilising the soil. We have seen also, that when man began to work in metal he needed timber to give him charcoal with which to smelt the ores.

To-day, though we have so many other materials to help us, we need more and more timber than ever. Wood is used for railway sleepers, for building houses and ships, for furniture, for the manufacture of paper and artificial silk, and in many other ways. In a number of places it is still used as a fuel, sometimes even for trains and in factories, where other kinds of fuel are scarce.

Timber is obtained from forests. In the past these must have been much more widely spread than at present, for man has been felling trees for hundreds of years, either to use the timber or to make room for his houses and fields.

To tribes with nothing but stone tools the forest was a barrier: it could not be removed. Even the Romans, who made so many roads across Europe, were stopped by the great forests of Central Europe. Only later, as the number of people grew, did man really turn against the forest and hew it down so that he could grow grain, rear cattle, and build villages and towns where the trees had once spread their branches. He has destroyed so much forest that to-day new forests have to be

[Courtesy, Canadian Government.

Gathering logs into piles in an eastern Canada forest.

planted and old ones carefully tended. In the case of the forest, as in the case of food, man is, at last, learning to cultivate as well as to destroy. At some of the universities there are now Schools of Forestry, where men are trained in the art of looking after trees.

There are three chief kinds of forest:

1. The northern coniferous forests, that is, forests of trees that bear their seeds in cones, such as pines, spruces, firs, and larches. These provide soft woods.

2. Forests that grow farther south, but still in temperate lands such as the British Isles. The trees such as oaks, maples, birches, poplars provide hard wood.

3. The forests of tropical lands, where the trees, such as mahogany, teak, and ebony, give the hardest woods of all.

Let us look at the coniferous forests of the north. They stretch all round the northern continents in a belt that passes right across Canada and the continents of Europe and Asia, from Norway to the shores of the Pacific Ocean.

In these parts of the world the winters are long and very cold, but the summers are warm enough to allow trees to grow. In these forests the commonest trees are pines, spruces, firs, and larches. There are several other kinds, but nothing like so many kinds as there are in the forests of hot regions. It is thus easier to obtain, in a coniferous forest, a lot of timber, all of the same sort, than it is in a tropical forest.

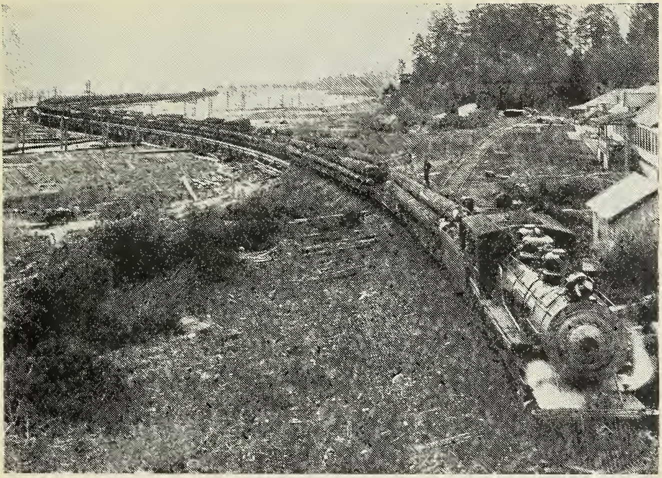
Trees obtain most of their food by means of their leaves, from a gas in the air. So, in these northern forests, they do not shed their leaves in autumn as most English trees do: the northern summers are so short that there is no time to waste in growing and shedding leaves. To make the best use of all the warm summer days the trees keep their leaves all the winter: they " go to sleep in their clothes."

Trees obtain their supplies of water through their roots, and let all they do not need escape through their leaves. In winter, when the gound is frozen, no water can be taken into the tree by the roots, and therefore very little must be allowed to escape through the leaves. For this reason the leaves are very small and shaped like needles: they are more or less waterproof.

Coniferous trees, as we can see, are well suited to cold lands. The snow that falls in winter does not readily lodge on the needle-shaped leaves or the drooping branches. A good deal slips off to the ground and so does not damage the trees by its weight.

One great enemy of the forest is fire, and nowadays a look-out is kept, often by aeroplane, for the beginnings of a forest fire so that it may be quickly checked.

The timber from coniferous forests is good for most ordinary



[Courtesy, Canadian Government.

A train carrying logs to the river.

purposes because it is soft and easily worked, but for ships, railway carriages, and other things that are expected to last for a long time, harder woods, such as oak and teak, are employed.

We have only to look around us to get some idea of the enormous amount of timber used in our own country: we can see that thousands of trees must be felled every year to supply us with telegraph poles, railway sleepers, doors, rafters, floor-boards, window frames, and with props to hold up the roofs of the coal pits. Most of this timber comes from the coniferous forests in Sweden and other countries round the Baltic Sea or from Canada. In this chapter we have time to visit only the forests of Canada, but the work in most coniferous forests is very much the same.

Before the work of felling the trees, that is, *lumbering*, begins, a

surveyor visits the forest to make a map of it. He finds out how many cubic feet of wood there are in the trees to be felled, and he shows, on his map, the best place to build the camp, usually near a spring or a small stream, and the best ways along which the trees can be hauled away.

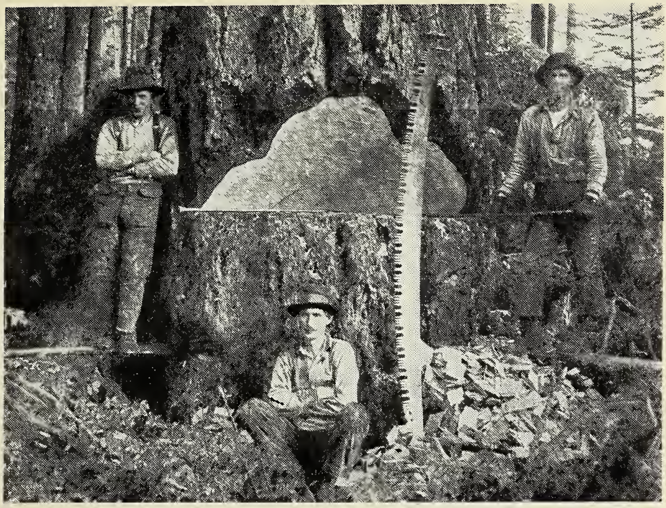
In the autumn one party of men goes into the forest to get things ready for the lumbermen. The party cuts down a number of trees to clear the ground that has been chosen for the site of the camp, and puts up the camp buildings. These are well and strongly built, for the lumbermen, of whom there may be a hundred or more, will be staying for several months, and the more comfortable they are the better they are likely to work.

The buildings include bunk-houses where the men sleep, a cook-house where the meals are eaten as well as cooked, an office, a tool shed, stables, a granary, stores, and a blacksmith's shed. They are made with round logs, except in the roofs and floors, for which planks are used. The roofs are covered with a layer of tarred felt to keep out the water formed by melting snow. The sleeping quarters are fitted with two rows of bunks, one above the other, as on a ship.

The cook is a very important person, for the lumbermen have enormous appetites, and demand plenty of good and well-cooked food. At meal time they sit at tables of rough boards covered with shiny American cloth.

The blacksmith's shop is usually a very busy place. Here axes and saws are sharpened, horses are shod, sledges and hauling chains are mended, and lorries and tractors kept fit for use. In the office one or two clerks make out the pay rolls, keep account of the camp stores, and write down the amount of timber that is cut and hauled away.

By the beginning of the winter the camp is finished and the lumbermen arrive. The trees in most parts of the coniferous forest are felled only in the winter when the ground is frozen



[Courtesy, British Columbia Timber Commissioner.

A gang of three lumbermen, with the big saw that two of them use.

hard and covered with slippery snow. The snow gives a surface along which the logs can be hauled more easily than they could be in the summer when the ground is soft and wet.

The lumbermen lead a hard life. They rise before daybreak and begin work as soon as it is light. They work in different gangs, each with its own special job. The men who cut down the trees work in gangs of three. Two of these use a big saw, with a handle at each end: the other, the " boss," uses an axe. The boss swings his axe, time after time, and cuts a deep notch on that side of the tree on which he wants it to fall. The two men with the saw then attack the other side, sawing slightly downwards towards the cut.

When the tree begins to totter a loud cry of " timber " is

heard, giving warning to all the other men who are working close at hand. After a few more strokes down comes the tree with a deafening crash. The axeman lops off the branches, and makes one or two marks along the trunk, usually about sixteen feet apart, to show where he wants the sawyers to cut it into logs. By sunset a group of three men may have as many as two hundred logs to show as the result of the day's toil.

While the fellers are working, another gang is busy hauling logs along slippery skidways to some central collecting dump. Sometimes horses are used for this work, but in the larger camps the timber is drawn along by a wire rope attached to a steam-engine. At the dump the logs are counted and measured, and stamped by a hammer with the owner's special mark. The logs are then loaded on sledges, and hauled by horses or by traction engine to the nearest river, where they are rolled on to the bank, there to wait till the ice melts.

With the fading of the light all the men return to the camp to see what the cook has in store for them. After supper, the one really big meal of the day, they go to the bunk-house to read books that they borrow from the camp library, or they have a sing-song or perhaps just a quiet smoke round the fire.

All through the winter the work of felling and hauling goes on until the spring comes and the snow melts. Then the lumbering party is paid off and the men return to their homes in the towns or, perhaps, go southwards into the prairies to help on the wheat farms.

In the spring the watermen begin their daring work of transporting the logs down the rivers. When the ice cracks up and the snow on the land melts, the streams become raging torrents. Then men with long poles roll the logs into the water and send them hurtling downstream. Every attempt is made to clear all the timber away before the level of the water falls, when the logs would be likely to be stranded in the shallows. Where the

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Watermen at work among the logs on a river.

streams are only small, dams are built to raise the level of the water. On the dams men have a very busy time guiding the logs through a narrow chute and sending them on their way.

Sometimes one or two logs stick and hold up the others till a great pile of timber, called a *jam*, is formed. In such a case the men have to spring from log to log across the icy water to try to break up the mass with their long staves. Should they not succeed they may have to loosen the jam with a charge of dynamite. The logs float loose in very rapid water, but when they enter the still water of a lake they are stopped by a boom made by a number of floating tree trunks chained together. When a sufficient mass of timber has collected it is made into a

rough raft and towed across the lake to the outlet where the logs are once more sent downstream to the saw-mills.

The mills are generally placed near rapids or waterfalls, which supply electrical power for working the machines. At the mills the logs are hauled up a sloping platform into a large room, where they are cut up by circular saws into planks and boards of all shapes and sizes. These are taken out into the yard and piled up into great stacks in such a way that the air can pass between them and dry all the pieces. Sometimes, however, the timber is taken to another workshop, where it is planed smooth and manufactured into house fittings such as doors and window frames.

It is from wood from these forests, too, that all our cheap paper is made. If all the rolls of paper used by one of the greatest London newspapers in one day were unwound, it would stretch from London right across the Atlantic to New York. When we think of all the newspapers that are published in all the cities of the world, we can see what an enormous amount of wood must be used to produce this huge amount of paper. Not much timber is brought to England to be manufactured into paper. It is first converted into a material called *wood pulp*. In the mills where this wood pulp is made the logs are sliced up into fragments and then changed to a fluffy mass, either by whirling grindstones or by treating them with strong chemicals. The pulpy mass is then mixed with water and run over a moving canvas band. The water soaks through the canvas, and the wood fibres are left matted together. The canvas then passes over hot rollers, which drive off the water and leave the wood pulp like sheets of dry cardboard. Most of the paper and wood pulp manufactured in Canada is sent southwards into the United States. If all the timber that is sent to the States in a year were to be stacked up on a football pitch, it would make a solid block over two miles in height.

In recent years another great use for wood pulp has been

discovered. From it rayon, or artificial silk, is made (see Chapter 15).

Much of the timber that is felled in Sweden is employed in the manufacture of matches. Not very much wood is used in making a penny box of matches, but Swedish manufacturers alone sell about £2,000,000 worth of them every year: this means the felling of more hundreds of trees.

EXERCISES

1. Give examples of trees giving soft wood, hard wood, and very hard wood. On a map of the world showing the climatic regions, mark where each of the trees you mention grows.

2. What change is taking place in man's use of the forest? Find out where new forests are being planted in Great Britain.

3. Make a list of the names of fifteen things that are made from the wood of coniferous trees.

4. State how each of the following factors has helped the development of an important lumbering industry in northern Canada:

   (*a*) The long cold winters.
   (*b*) The snow.
   (*c*) The great number of lakes and rivers.
   (*d*) The presence of rapids and waterfalls.
   (*e*) The easy access to the sea.

5. What countries in Europe resemble the forest lands of Canada?

Write four short paragraphs to show how they resemble each other in their (*a*) climate, (*b*) vegetation, (*c*) types of rivers, and (*d*) the number of small lakes.

6. Draw a map of the shores of the Baltic Sea. Name four islands, four straits, and three gulfs.

Name and make a dot to show the positions of Danzig, Stockholm, Göteborg (or Gothenburg), Riga, Copenhagen, and Leningrad.

7. Write a brief description of the work in a lumber camp.

8. The following table gives the weight in ten thousand tons of wood pulp and paper imported into the United Kingdom in 1933.

From	Pulp	Paper
Finland	75	13
Sweden	56	17
Norway	52	9
Canada	1	11
Newfoundland	1	14

What is the principal use of this pulp and paper? What country buys most of Canada's pulp and paper? Assuming that all the pulp was made into paper, and that all the paper was used in one year, work out how much paper is used every day.

9. One of the chief saw-milling centres in Canada is situated in the suburbs of Ottawa. Draw a map to show the position of Ottawa and find out all you can about its importance.

PART THREE: HOW MAN SHELTERS HIMSELF

CHAPTER 17

HOUSES

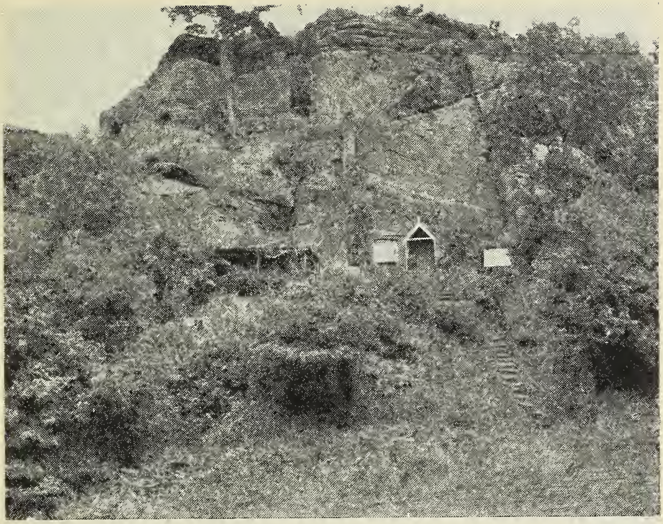
MAN'S most important need is food. After that comes the need for shelter—against wild animals, human enemies, and the weather.

Perhaps the earliest homes in which men lived were caves. There are still many parts of the world where caves are used, as they were by the people of the Old Stone Age, merely as shelters. And in a few places, as, for instance, in parts of Staffordshire, in England, caves have been turned into cottages.

In the New Stone Age men dug holes in the ground. With the earth that they removed from the hole they made a wall, which was strengthened with stones. Sometimes the stones were gradually pushed inwards, as the walls rose, so that they made a roof. In that case the finished house had the shape of a big bee-hive. In other cases, if skin, brushwood, or turf were easily obtained, these materials were used, instead of stones, for the roof.

Huts were also made by driving stakes into the ground, working branches in and out between them to form a framework, and then filling in the holes with mud.

In some such simple kinds of ways did the building of homes begin. The builders did not bother very much about making their homes beautiful or about shutting themselves off from their neighbours. What they chiefly wanted was a place where they could sleep in safety. They wanted protection against wild animals and human enemies.



[Valentine.

Caves in Staffordshire which have been turned into cottages.

New Stone Age man, for this reason, sometimes drove piles into the beds of lakes and built houses on planks that he laid across the piles. He was surrounded by water and could be reached only by boat. " Pile dwellings " of this kind are still in use, and for the same reason, amongst the natives of New Guinea.

In some countries houses are placed in the trees. They are reached by a ladder, and the ladder is pulled up when the people go to bed at night.

To-day, in civilised countries, we are not troubled either by wild animals or by human enemies, except perhaps, by burglars. But, like early man, we still have to think about the weather.

[E.N.A.

Pile dwellings in New Guinea.

In some tropical lands it may happen that the natives need to be protected only from the wind. They live in the open, but plait straws into a mat, and hang the mat on sticks driven into the ground on the side from which the wind comes. In the wilder parts of Persia, the natives sometimes use an oak tree as a house in the summer. All they do in the way of building is to set up a wind screen round the lower part of the trunk. They hang their goods in the branches above them.

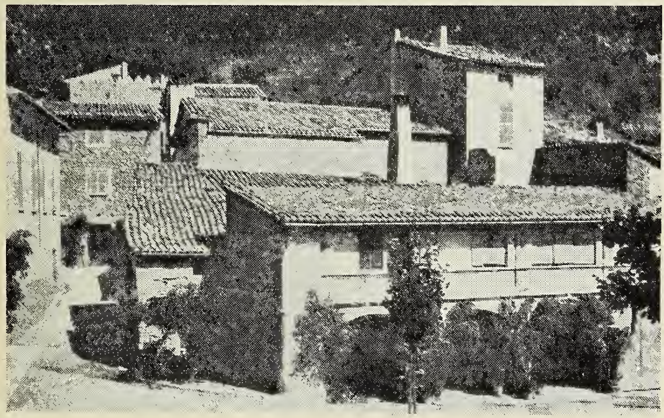
The effect of the weather is seen in many ways. In lands like Egypt, where there is little or no rain, the roof is flat. In

lands like those round the Mediterranean Sea, where there is some rain but little snow, the roof slopes gently, so that the rain can run away. In countries farther north, where there is snow as well as rain, the roofs are often steeper, in order that the heavy load of snow may slide off as quickly as possible.

In Switzerland the roof ought to be steep to shed snow, but it is often flatter than we should expect, because the winter wind is wild and strong. Heavy stones are placed on the roof to prevent its being lifted by the wind and blown away.

The kinds of windows in use, all over the world, depend on the sun. Where there is too much sun there are often no windows at all, so that the house may be cool and dark as a relief from the heat and glare of the outdoor world. Where there is less sunlight, as in Britain, windows are large to let in as much light as possible.

The material used in building dwellings, all over the world,



Gently sloping roofs of houses in Mediterranean countries.

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Zulus building a reed hut.

and in all ages, was something that could be found near at hand. In these days this is not quite so true.

Consider first the hunting peoples. They are always moving and have no beasts of burden. They must have shelters that are light to carry and that are easily put up and taken down. This is also true of the herders, but they can have heavier tents because they have camels, horses, or oxen to carry them. The North American Indians had tents of wood and skins. The Kirghiz use willow hurdles lashed to posts in the ground and stretch over them thick felts made from the wool of their herds.

The cultivators, manufacturers, and miners do not have to move about. They can stay at home, and their homes can be built of anything that the earth provides for them.

In some parts of the Arctic regions the Eskimos make a circular wall of stones and plaster mud between them to fill the holes. Wooden supports are placed inside to hold up the roof.

But where they have to pass the winter in a land covered with snow and without trees, they use snow.

Zulus build huts by plaiting reeds to form a framework. These they cover with layers of grass, reeds, and mud; other peoples may use straw or leaves.

In lands covered with forests the commonest building material is wood. This is the case in many tropical countries, where bamboo, teak, and palm are employed, as well as in the

[Courtesy, German Railways.

Wooden houses in Germany.

cooler countries, where the pine trees grow. In Siberia, Northern Russia, Finland, Norway, Sweden, in Canada, and in much of the United States, wood is used in building, not only houses, but churches, hotels, and public buildings.

Where wood is not abundant, materials are dug out of the ground—sandstone, limestone, granite, clay. From the clay bricks are made. Clay bricks have been in use for thousands of years. They may be dried in the sun, or they may be baked hard by fire. Brick is the most common building material in the plains of England and of Western Europe. There are thousands of brick houses, factories, churches, and other buildings in most parts of England, in Holland, Belgium, and Germany, and also in New York, Philadelphia, and many other cities in the east of America.

We hear a great deal, in these days, about the "housing problem," that is, the problem of how to build enough houses for people to live in comfortably without having too many people in one house and without making the rent so high that people have not enough money left with which to buy food.

The problem is a new one and did not trouble early man at all. As a matter of fact, it did not trouble anybody until times quite near our own. It is not so very long ago that men could easily build their own simple cottages and thatch the roofs themselves. But to-day, men who live in towns and work in factories and offices would be very much puzzled if they had to put up their own houses.

Another great change has taken place. A man may no longer in England, for instance, build a house just where he pleases, and in any way he likes. Houses have now to be built according to laws that have been made to keep people healthy.

If bedrooms are of a smaller size than the law allows, even if they have big windows, they must have open ventilators, built in the wall, to keep the air in the room fresh. This

[E.N.A.

A row of modern flats in Vienna.

was not so only a hundred years ago. We still have many houses with no water supply inside, with windows from which sun and the fresh air are shut off by other buildings, and with only one wash-house and lavatory for several families. Fortunately, every year some of these wretched buildings, often with roofs that leak and walls that are full of vermin, are pulled down.

To make room for the people from these crowded slums is difficult in large towns. Indeed, it is difficult to build houses for people with more money to spare, because the land in big cities is badly wanted for so many purposes. Hence, for rich and poor alike, people are beginning to live in flats, that is, in homes built one above another. Many people do not like them because they have no garden of their own and the noise from another flat is closer and more annoying than that from a house next door. But flats have come to be part of our modern city

life; perhaps, in time, sound-proof walls and ceilings and open spaces outside will make them more comfortable.

Yet another change has taken place in recent times. We are now trying to plan houses so that they shall form an artistic as well as a useful part of the city or country. Here and there, a beautiful old village, such as West Wycombe, has been preserved by law, so that its charm cannot be spoiled by careless building in or near it.

All this brings us a long long way from times when caves or holes scooped in the earth served as the houses of human beings.

EXERCISES

1. Name materials used for building houses and give the name of the country in which each is used.

Material Used	Country	People

2. Write short accounts of (*a*) brick making, (*b*) slate quarrying, (*c*) stone quarrying.
3. In what parts of the British Isles would you expect to find (*a*) slate roofs, (*b*) thatched cottages, (*c*) stone cottages, (*d*) concrete cottages?
4. Name countries where man needs his house to shelter him from (*a*) sun, (*b*) rain, (*c*) snow, (*d*) mosquitoes. In each case show how he obtains the kind of shelter he needs.
5. Name two types of houses which are being pulled down to-day, and give the reasons for their destruction.

CHAPTER 18

TOWNS

MEN, at all times, even the earliest, have always liked to live together in groups. Sometimes these groups were wandering tribes, such as are still to be found in the remote parts of the world. Groups of hunters and herdsmen, however, were apt to be small, for if there were too many people in one place the game was soon destroyed or frightened away, and if the herds were too large the pasture was soon all eaten. Hunters and wandering herdsmen had no use for towns: they moved about too much.

When, however, the New Stone Age set in, and men learnt to cultivate the same piece of ground year after year, there was enough food to keep a group in one place. There was no longer any need to roam, and clusters of huts became quite common. Some of these clusters were large enough to be called villages. When a village consisted of a group of men who had hacked a clearing in the forest and were cut off, by the forest, from other villages, it remained small and lonely. But when the village was in a rich agricultural land, such as Mesopotamia or Egypt, it was often close to other villages, and, after a time, two or three villages near to each other might join together to form a bigger group called a town or city.

Remains of such ancient cities are to be found in Mesopotamia and Egypt, along the coasts of Greece, and on the islands near those coasts. The Romans, at a later date, were great builders of cities, and after Rome had lost much of her power cities continued to spread through Western Europe. Most of these cities had a bishop to look after the religious life of the people, and a castle in which lived the knight or the lord of the

[Courtesy South African Government.

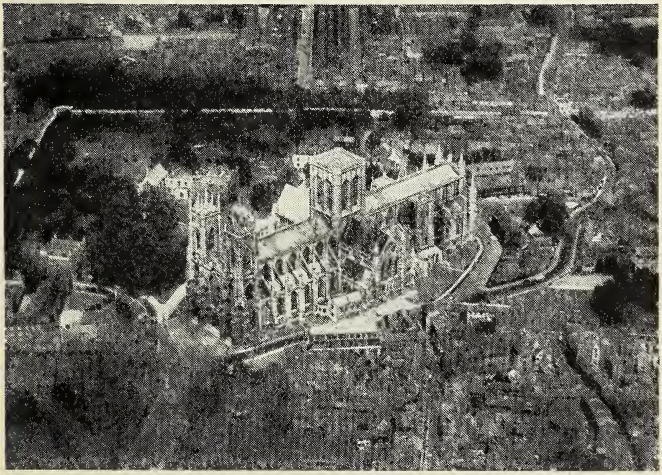
A cluster of native huts in Natal.

manor, whose duty it was to defend the city in time of war. Merchants and traders naturally came to live in the city because the castle made them feel safe. Among the other inhabitants were the workers in arts and crafts.

The city was surrounded by a wall, and the gates were closed at night. In some old towns in England, for instance, Canterbury, York, and Chester, it is still easy to trace the ancient walls. Outside the walls grew up villages which supplied food for those who lived in the town. In times of danger the villagers often took refuge within the walls. Thus the plan of English cities of an early date usually included a castle and a cathedral near together, and a market-place close at hand where merchants and traders could show their goods and peasants sell their produce. Most of the cities were built on or near the banks of a river, so that water could always be obtained.

In Britain, for a long time, the chief towns were either the market towns or the seaports. Most of the people lived by agriculture and depended on what they grew. They spun their own linen and woollen thread and made their own cloth and clothes. They made, also, their own jams, pickles, candles, soaps, and even some simple medicines. They sold any produce which they did not need, and bought a few articles in the market town. These old market towns are to be found where several roads meet.

There were a great many small ports, for sailing ships were not very big and did not need deep harbours. From these small ports goods were carried by sea to other parts of the country, because water transport was cheap. Transport by



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York photographed from the air. The ancient city walls can be clearly seen beyond the Cathedral.

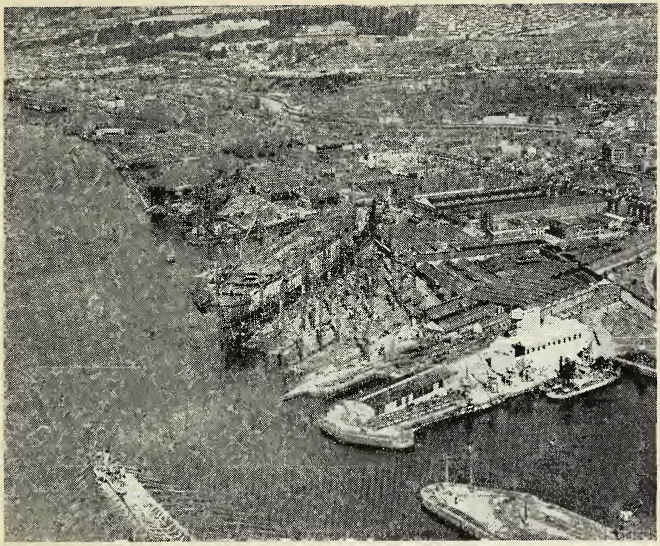
land was by pack-horses for goods and by horse and coach for passengers, but the roads were bad and movement on land was dangerous and slow.

A great change came with the use of steam for driving machinery. Mines and factories sprang up in what had been remote places. Thousands of people collected together in new towns that were built in a hurry. These towns are without any beauty, and are overhung by a cloud of smoke and grime.

To-day in Britain, as elsewhere, there are several different kinds of towns. There are the great *seaports*, such as London, Liverpool, Southampton, Glasgow, or Belfast. They have taken the place of the old little ports, because modern steamers need big harbours and docks. As a rule they are well inland, as far as possible up the river estuaries. Large liners and cargo steamers need sheltered water in which they can load and unload. They steam up the estuaries at high tide and enter the docks. As the tide goes down the dock gates are closed, the water in the docks remains high, and the ships are kept afloat.

Some of the great ports, such as those on the Tyne and the Clyde, are also great shipbuilding centres. Other ports that lie well out to sea, the *packet stations* or *ferry ports*, are more like stations. Here people change from boat to railway train. Dover, Folkestone, and Harwich are ferry ports for the Continent, while Stranraer in Scotland and Holyhead in Wales are ferry ports for Ireland.

Then there are the *fishing ports*. These usually have fine sheltered harbours, and are near the fishing grounds. They, too, are well out to sea, so that the fish can be landed as quickly as possible. A century ago nearly every seaside village had its own fleet of small sailing boats which was used to catch fish within a few miles of the shore. Now, steam trawlers from England go far afield. They visit the Dogger Bank, the White Sea, the south-west of Ireland, and the sea surrounding



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Shipbuilding on the banks of the Clyde.

Iceland; sometimes they are away for two or three weeks at a time. These trawlers may carry about 250 tons of coal and about 50 tons of ice, so that at the port there has to be an ice factory and a quick method of loading the ships with coal. The small village fleets have now died out, and most of the big fishing ports, such as Grimsby, Hull, Fleetwood, and North Shields, are near the coalfields. At these ports there is plenty of work to be done. The trawlers have to be kept under repair, the nets have to be mended and tarred, and the catches have to be unloaded, sold in the fish market, and packed into barrels or boxes to be taken by trains to inland

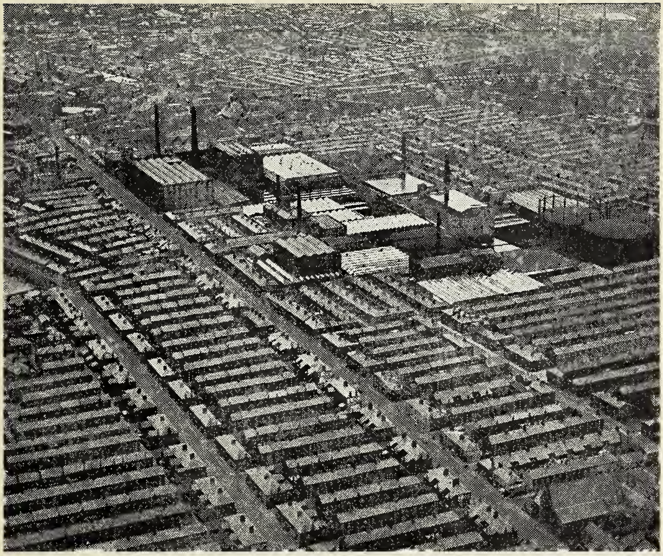
towns. The men doing this kind of work live in large towns near the harbour.

Then there are the *manufacturing towns*—cotton in Lancashire, wool, iron, and steel in Yorkshire, pottery in Staffordshire, and motor-car and aeroplane factories in the centre and south-east. Most of the cities that we have read about in this book are industrial centres of this kind. The history of many of them is something like the following. A coal-mine is dug in the midst of fields, but near a railway and a main road. A few thousand colliers are employed and, as they want to live near their work, rows and rows of houses are built near the coal-pit and a town rapidly springs up.

Coal is heavy, and it is a costly matter to carry it over long distances. It is much cheaper near the pit-head and, on this account, one factory after another is built, and more houses and shops are erected to meet the needs of the workpeople. The men who earn higher salaries prefer to live a few miles out of the crowded town to enjoy the country air. They live in the surrounding villages and come to work in the morning either by car or train. They generally choose the villages on the western side, because the prevailing westerly wind blows the smoky air away to the east.

As the town continues to grow more collieries are made and more works and factories are built on the outskirts; the larger houses become surrounded with workmen's villas. Trams and buses now run along the main roads, and the workpeople who live in the suburbs can reach the factories quickly and cheaply. Thus the town grows bigger and bigger, always spreading outwards along the main roads.

When the town is large the rents in the centre are high, and it often pays a firm to move away and build a new factory on the outskirts of the town. The old factories are then converted into offices or warehouses, and many of the houses are



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Rows and rows of houses in which live the workers who work in the cotton mill in the centre.

changed into shops. The old part of the town ceases to be a manufacturing area, but becomes the business and commercial centre of the area.

Some modern towns are of a kind that is quite new. There is, for instance, the *pleasure and holiday resort* where those who have been shut up in town all the year can go to breathe the pure fresh air of the sea or country-side. The largest of these are on the coasts, and near the great cities. In the south of England are Brighton, Southend, Hastings, Eastbourne, Margate, and Bournemouth for the Londoners;

Lancashire people go to Blackpool or Llandudno; those living in the Midlands may prefer Skegness or Yarmouth.

Another kind of town which is quite new is the planned *garden city*, such as Port Sunlight, Bournville, Welwyn Garden City, Letchworth. These are attempts—much easier now that electric power can be used instead of steam—to build small towns, with some factories to provide work for the inhabitants, in such a way as to allow the workers to live in pretty cottages with large gardens, and to make factory life clean and healthy.

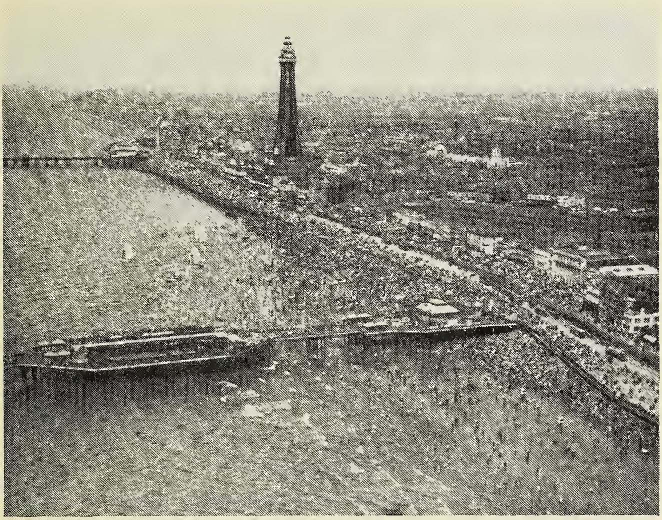
To-day, as of old, towns and cities in England are governed by elected councillors, with the Mayor at their head. So much work is now necessary for the welfare of our towns and cities that committees for special purposes, such as Education, Health, Finance, Housing, and Libraries, are set apart to look after these special sides of city life.

One of the newest committees is the Town-planning committee. This tries to arrange that new building and road-making shall be done in such a way as to ensure both convenience and beauty. It also considers reports from the medical officer as to houses that are unhealthy to live in, and tries to plan to replace them by better and more beautiful houses and flats. Another very important part of its work is to plan for parks and playing fields.

The small market towns, so long half decayed, are beginning to benefit by the recent changes in transport. They are now often visited by motorists interested in their old buildings, while the motor-bus has linked them with the smaller villages around, so that they are becoming shopping centres.

Just as motor-buses are bringing the villages into quick touch with the nearest town, so aeroplanes and motors are bringing our cities into quicker contact with one another.

These newer ways of moving about, together with the



Crowds of people on holiday at Blackpool. [Topical.

telephone and the wireless, are lessening the local differences between people of one city and another.

Since the hard times that have fallen on some coal-mining, shipbuilding, and other formerly wealthy cities, efforts have been made to move people to places where there are more chances of work. For the last few years the population has been moving to the south-east of England, where several new industries are quickly growing. But the people in the north belong to a time when people stayed in one place all their lives, and the old folk, especially, will suffer much hardship rather than leave the place they love. Yet these places are, in some cases, dying so rapidly that towns which, twenty years ago, were prosperous, now have three-quarters of their people unemployed.

Loyalty to and pride in the city to which one belongs have, in the past, helped greatly to keep villages and towns and cities healthy and progressive. One of the great dangers of the big cities to-day is that the people in them do not feel able to know and love their city as of old. So the growth of the new smaller towns now being built, to which electric power can be carried cheaply for factory and home, is very important.

We do not know whether the Old Stone Age man loved his cave or the New Stone Age man loved his hut. But we do know that the men of the cities that were built in later times were proud of them and did much for them. You may well make up your mind, if you live in town or city, to say, like the men of ancient Athens, " We will never bring disgrace on our city by an act of dishonesty or cowardice. . . . In all ways we will transmit this city, not only not less, but greater, better, and more beautiful than it was transmitted to us."

EXERCISES

1. Make a map of England showing (*a*) the great textile manufacturing towns, (*b*) the coal-mining centres (*c*) six old cathedral and market-towns.
2. Mark on a map of the coast of England with different signs (*a*) the great ports, (*b*) the naval ports, (*c*) the great health resorts, (*d*) two small decayed old ports, (*e*) fishing ports.
3. Find out all you can about the way your own town is governed. Write down any changes in it which you or your parents have noted, and any street names that tell you something about the history of the town.
4. What is the population of London, Southampton, Liverpool, Newcastle-on-Tyne, Birmingham, Stafford, Crewe, and your own town ?
5. In what towns are the following things made: steel goods, bicycles, motors, pottery, boots and shoes, nails, wooden doors and window frames, aeroplanes ?
6. Write down the names of three towns which are growing rapidly, three which are decaying. Try to find out the reason for the growth or decay.
7. Is there any housing problem in your town ? If so, describe it, and say whether anything is being done about it.
8. Is anything done by your town to prevent children being maimed and killed in your streets ? Sunderland has for some time been the only city with no fatal motor accidents. Why is this ?
9. Mark your own town on the map, and also the nearest seaport and the nearest health resort. Show on your map both the roads and the railways to these places.
10. Draw a plan of your own town, and indicate on the roads and railways to what towns they go.

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